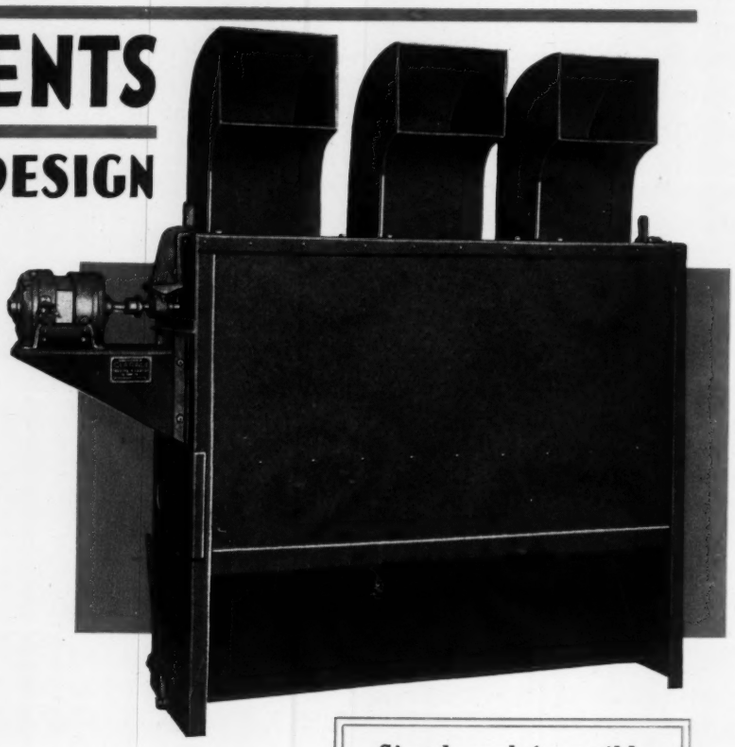
Engineering
Library

MAR 10 1930

# Heating · Piping and Air Conditioning

# SOME VERY IMPORTANT IMPROVEMENTS IN UNIT HEATER DESIGN



FOR industrial heating — especially for large area heating—we believe that Clarage UNITHERM Unit Heaters are the most desirable equipment you can buy.

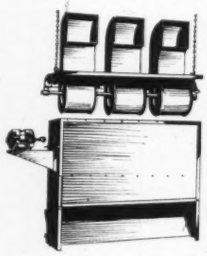
First, the UNITHERM is equipped with centrifugal fans. Heat is delivered under positive pressure, assuring quick, uniform results.

Second, the fans incorporate a self-limiting horsepower characteristic. The UNITHERM, with heating coil removed, can be used for summer ventilation—capacity increased, yet no danger of motor overload.

Third, the UNITHERM is the most compact of any type. It has the highest BTU rating for the amount of space it takes.

Finally, the UNITHERM is built to last—built by a company with an established reputation for sound engineering—built to give dependable service year after year. The motor is ball bearing; Universal Aerofin the heating element.

*Simple and Accessible*



EVERYTHING about the UNITHERM bespeaks low maintenance. Entire heating coil can be removed in a few minutes. Entire fan assembly can be lifted up and out as shown above. The design is very simple; all parts easy to get at.

***By All Means Get This Story of Progress***

CLARAGE FAN COMPANY
KALAMAZOO, MICHIGAN

Without obligation, send me Catalog shown above giving full details on Clarage UNITHERMS.

Name.....

Address.....

City.....State.....

# *The* CLARAGE *Unitherm*

# TABLE OF CONTENTS

MARCH, 1930


Page

THE EFFECT OF TWO TYPES OF CAST IRON STEAM RADIATORS ON AIR TEMPERATURES IN ROOM HEATING ..... 185
*By A. C. Willard and M. K. Fahnestock*

PIPING—WHERE RELIABILITY AND COMPACTNESS ARE ESSENTIAL ..... 192
*By E. W. Sylvester*

DUST HAZARDS AND PROFITS ..... 196
*By. H. C. Murphy*

SPECIFICATIONS FOR HEATING AND VENTILATING ..... 199
*By Samuel R. Lewis*

INSTALLATION AND CARE OF AIR PIPING ..... 203
*By A. W. Loomis*

THE THERMAL LOAD DIAGRAM ..... 208
*By Herman Vetter*

STEAM, WATER, AIR AND OIL PIPING FOR RAILROAD YARDS 210

COOLER-HUMIDIFIER FOR PRODUCER GAS ..... 215
*By Linn B. Bowman*

LOW TEMPERATURE INSULATION AS APPLIED TO PIPING SYSTEMS ..... 218
*By C. T. Baker*

BALANCING INSIDE-OUTSIDE CONDITIONS ..... 220
*By Malcolm Tomlinson*

TRAP INSTALLATION AND OPERATION ..... 223
*By T. H. Rea*

"OPEN FOR DISCUSSION" ..... 226

SOME FUNDAMENTALS OF HYDRAULIC PIPING ..... 229
*By Frederick G. Schranz*

EDITORIALS ..... 277

INTERVIEWS OF INTEREST ..... 278

PRACTICAL PIPING PROBLEMS ..... 279
*By W. H. Wilson*

ADVERTISERS' INDEX (ADVERTISING SECTION) ..... 188


## JOURNAL SECTION OF A. S. H. V. E.


36th Annual Meeting, Philadelphia, January 28 to 31, 1930 ..... 233

Entertainment at Philadelphia Meeting ..... 264

First International Heating and Ventilating Exposition ..... 266

Bulletin Section ..... 271



## BOARD OF CONSULTING AND CONTRIBUTING EDITORS

*Heating*
Samuel R. Lewis
Alfred J. Offner
E. B. Langenberg
James C. Peebles
John D. Small
Homer R. Linn
Lee P. Hynes
Frederick D. Mensing
A. K. Ohmes
Samuel E. Dibble
J. C. Hornung
John D. Preble
C. H. B. Hotchkiss
Ralph S. Franklin
A. Beaurrienne
T. S. Tenney

*Piping*
A. W. Moulder
Sabin Crocker
Lewis Lipman
E. O. Eastwood
A. R. Acheson
George B. Mulloy
J. J. Harman
C. W. Kimball
David J. Jones
Percy R. Owens
E. L. Ellingwood
R. P. Schoenijahn
C. S. Millard
R. C. Doremus

*Air Conditioning*
Dwight D. Kimball
Walter L. Fleisher
John Howatt
Frank B. Rowley
Alfred Kellogg
John F. Hale
E. P. Heckel
H. C. Murphy
Philip Drinker
R. S. Hawley
Charles S. Leopold
J. D. Hoffman

R. V. SAWHILL, *Editorial Director*

CHAS. E. PRICE, *Research Editor*

L. B. SPAFFORD, *Engineering Editor*

C. M. BURNAM Jr., *Associate Editor*



Published Monthly by **Engineering Publications, Inc.** 1900 Prairie Avenue, Chicago

TERMS OF SUBSCRIPTION

Anywhere in the world, $3.00 per year.

Current copies, 50c each. Back numbers, $1.00 each.



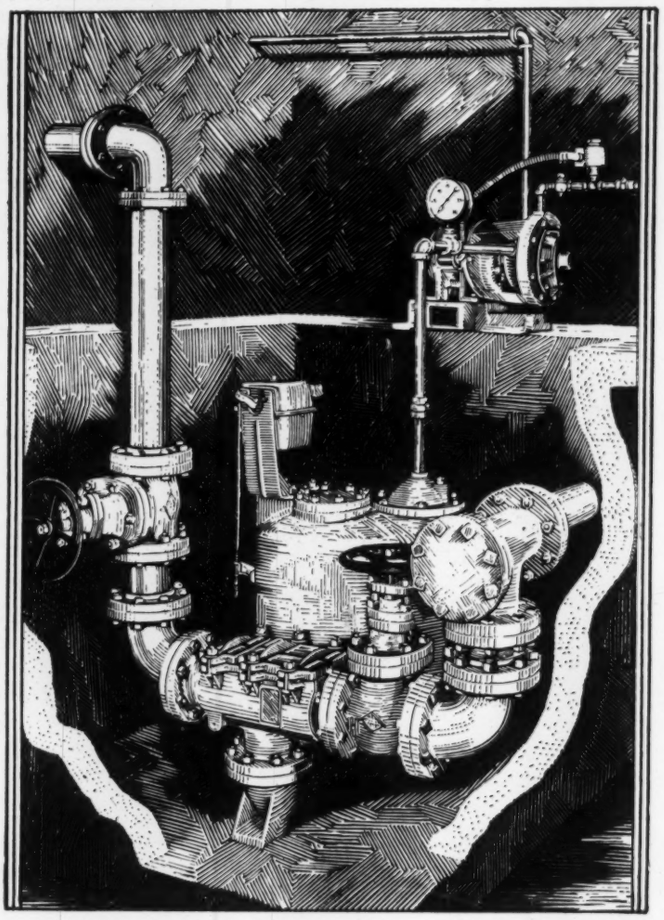
Copyright 1930, by Engineering Publications, Inc.



**F. P. Keeney,**
*President and Treasurer*
**E. DeForest Winslow,**
*Vice President*
**O. T. Carson,**
*Secretary*

Address all Correspondence to Chicago Office
New York Office, Room 1706-1707, 110 East 42nd Street
Pittsburgh Office, Room 604, Chamber of Commerce Bldg.
Detroit Office, Room 410, Donovan Bldg.
Philadelphia Office, Room 1507, Finance Bldg.

MEMBER AUDIT BUREAU OF CIRCULATIONS



Jennings Type B Sewage Ejectors have capacities of 30 and 50 g. p. m. Heads up to 50 ft. Type A, Jennings Units are supplied with capacities up to 1500 g. p. m.

PNEUMATIC EJECTORS are by far the most satisfactory equipment for lifting unscreened sewage from deep basements and discharging this sewage into the street sewer. But, until the Type B Jennings unit was developed, the pneumatic ejector was not available in small capacities.

# Now...

## a pneumatic ejector for handling 30 and 50 g. p. m.

A Type B Jennings Ejector compares favorably in first cost with other types of equipment. Unlike a sewage pump, it has no submerged impeller or other vital working parts to become caked with solid matter and lose efficiency. Air is compressed and supplied to the receiving pot at the required pressure, and then only when needed to move the sewage. Large inlets and outlets permit the Jennings Ejector to handle without clogging, anything that will pass through a four inch elbow . . . If you are not familiar with Jennings Sewage Ejectors, write for Bulletins 103 and 108 . . . The Nash Engineering Co., 71 Wilson Road, South Norwalk, Conn.

*Jennings Pumps*

Heating · Piping and Air Conditioning

Vol. II March, 1930 No. 3

# The Effect of Two Types of Cast-Iron Steam Radiators on Air Temperatures in Room Heating

*By* A. C. Willard[1] and M. K. Fahnestock[2]

## Introduction

THE investigation of heating rooms by direct steam radiators which has been in progress at the *University of Illinois* for the past three years has included a study of many factors, a few of which are yet to be completed, as follows:

1. Enclosures, shields, and covers.
2. Radiator location in the room.
3. Surface finish on radiators.
4. Storm sash at windows and doors.
5. Type of radiator.
6. Effect of insulation as applied to walls, ceilings and floors, separately and jointly.

Actual rooms subjected to typical winter weather conditions have been used, and in general, the radiator performance has been measured in terms of (1) steam condensed and (2) air temperature conditions maintained in each case. The results are published in Engineering Experiment Station bulletins[3] and sufficient data are now available to convince the most skeptical that the testing of direct radiators is by no means a simple matter. It is quite evident that a proper evaluation of radiator performance can not be made on the basis of steam condensation alone. In other words, radiators intended for room heating can not be tested independently of their actual operating environment—as shown by the results secured in the specially designed room heating testing plant used in this investigation and also in the actual rooms reported on in this paper.

In practically all previous tests of radiators, with one notable exception,[4] very little attention has been paid to

[1]Professor of Heating and Ventilation and Head of Dept. of Mechanical Engineering, University of Illinois, Urbana, Illinois.

[2]Special Research Associate, Dept. of Mechanical Engineering, University of Illinois, Urbana, Illinois.

[3]"Investigation of Heating Rooms with Direct Steam Radiators Equipped with Enclosures and Shields," by A. C. Willard, A. P. Kratz, M. K. Fahnestock, and S. Konzo. University of Illinois Engineering Experiment Station Bulletin No. 192. This co-operative research has been supported jointly by the Institute of Boiler and Radiator Manufacturers, the Illinois Master Plumbers' Association, and the University of Illinois, and has been in progress since April, 1926.

An earlier bulletin entitled "Effect of Enclosures on Direct Steam Radiator Performance," by M. K. Fahnestock, University of Illinois Engineering Experiment Station Bulletin No. 169, has also been issued in this series.

[4]"The Heating Effect of Radiators," by Dr. C. W. Brabbee. Journal of the American Society of Heating and Ventilating Engineers, November, 1925 and 1926.

This paper has three principal objectives. First—that comparisons of the performance of *different types* of direct radiators must take into account the "heating effect" on the air and contents of the room as well as the heat emission or steam condensation of the radiator. (With radiators of the *same type,* condensation tests may serve as a satisfactory basis for comparing the performance of radiators in heating rooms.) Second—that the heat loss from a room may be seriously affected by the *type* of heating unit installed although the heat losing areas remain the same. Third—that air temperatures taken at the "breathing line" 5 ft. 0 in. above the floor may prove a very unsatisfactory basis for comparing the performance of *different types* of heating units.

The paper suggests as a final recommendation a simple method of evaluating the "heating effect" of *different types* of heating units as installed in actual rooms, and illustrates a fundamental principle in the heating of buildings which will receive far more attention in the future than has been accorded it in the past.

The particular types of units dealt with in this discussion are of no special significance, since comparisons between enclosed and exposed units have been found to yield similar results, as well as comparisons between direct and indirect heating systems.

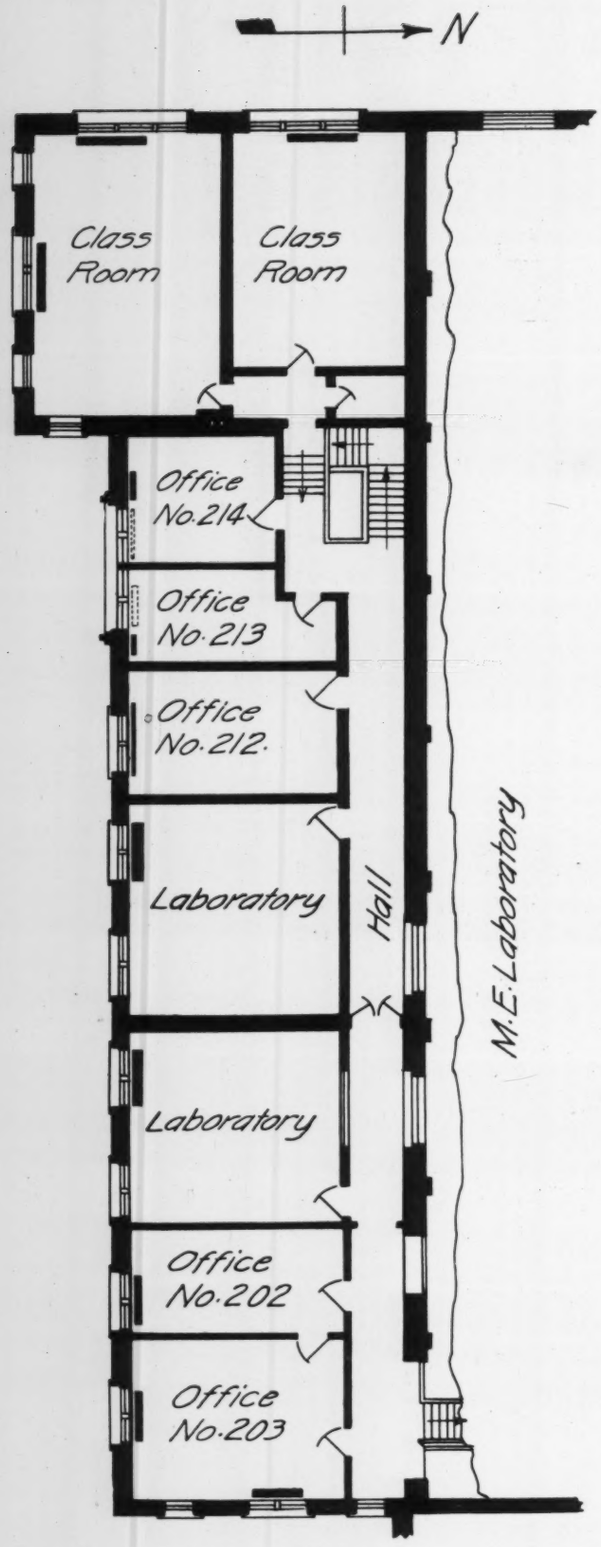



FIG. 1—PLAN OF THE SECOND FLOOR OF THE SOUTH WING OF THE MECHANICAL ENGINEERING LABORATORY

the range or difference in air temperatures between floor and ceiling. This difference has been found to range from 20 to 2.5 F in the same room, depending principally on type of radiator, and may also be influenced by enclosures and radiator location to a certain extent. It is, or should be obvious, that a radiator which maintains a "breathing line" (at a level 5 ft. 0 in. above the floor) temperature of 70 F and a "floor line" (at a level 3 in. above the floor) temperature of 60 F or less is not as satisfactory as another radiator which may maintain a slightly lower "breathing line" temperature, but a much higher "floor line" temperature so that the air temperatures surrounding the occupants are much more satisfactory and comfortable in the latter case than in the former. Add to this the fact that the "ceiling line" (at a level 3 in. below the ceiling) temperature may be many degrees lower with the second radiator than with the first, and finally, that a radiator having less actual heating surface may be used in the second case, actually condensing less total steam, and the inadequacy of former radiator testing methods becomes a matter of serious concern to manufacturers, installers, and owners.

With a full appreciation of the importance of the above facts as determined in the room heating testing plant at the *University of Illinois,* carefully conducted field studies in many actual rooms heated by various types of direct cast-iron steam and water radiators have been in progress during the heating season of 1929-30. These correlating field tests have confirmed the laboratory tests in every particular and will appear in full in a future bulletin of the Engineering Experiment Station. The present discussion presents data on studies of room air temperatures with two types of direct cast-iron radiators operating on low pressure steam.

### Description of Rooms and Radiators

The layout of the rooms (Nos. 212 and 214) which are a part of a group of offices on the second floor of the mechanical engineering laboratory at the *University of Illinois* is shown in Fig. 1. The ceiling height of each room is 10 ft. 0 in. and the ceilings are of lath and plaster with no insulation. The same attic extends over all of the rooms. This attic is about 10 ft. high at the peak in the center, the slate roof sloping downward and meeting both side walls of the building at the eaves. The temperature of the air in the attic as measured with three thermometers located 3 in. above the upper surface of the ceilings of the rooms, during the periods when data were taken, was practically uniform and ranged from 30 to 35 F, depending upon the outside temperature and the amount of sunshine striking the attic roof.

The floors of all the rooms are of concrete about 4½ in. thick and covered with heavy cork linoleum. The air temperatures below the floors of the rooms varied from about 65 to 70 F.

The exposed walls of the rooms are of brick, 13 in. thick, with no insulation, and the exposed wall and glass areas are the same in both rooms. There is no weatherstripping or storm sash on any of the windows, which are of the ordinary double-hung type, so that both rooms have the same amount of window cracks. The ceiling of room 212 has an area of 234 sq. ft., which is 78 sq. ft. more than the area of the ceiling in room 214. Otherwise, the heat losing areas and infiltration openings are the same in both rooms. Consideration of this difference in ceiling area will be discussed later.

The 27 sq. ft. radiator in room 212 (Fig. 2) was a long, low, narrow cast-iron wall type consisting of three 9 sq. ft. wall sections placed just below the windows.

The 36 sq. ft. radiator in room 214 (Fig. 3) was a cast-iron 38 in. high, 2-column type of 9 sections located against the wall beside the window. An uncovered drop riser and branch at the ceiling supplied each radiator with steam at a temperature of about 230 F, and the run out to radiator in room 212 was 2 ft. 6 in. long, or an area of 1.1 sq. ft.

### Conditions Under Which Data Were Taken

Certain precautions must be observed in taking air temperature measurements in a room if reliable and comparable data are to be obtained. All of the data were obtained under similar conditions and are, therefore, directly comparable. They were obtained from 9:00 to 10:00 a.m. on mornings following continued low outside temperature for periods of at least 24 hours duration. The average outside temperature for the 24-hour period preceding each test is included in Table 1, along with the outside temperature at the time of the test. The temperature for the 24-hr. period is probably the more important of the two, as the effect of varying outside temperatures on air temperatures within a building will always lag behind variations in the outside temperature.

The readings were taken in the mornings because at that time the rooms had not been disturbed from the state of equilibrium arrived at during the night when they were unoccupied. Doors to all rooms were always kept closed at least 12 hours previous to recording any temperature data. On the nights preceding the mornings when data were to be taken, all windows and doors were closed and locked, and all radiators were checked and found to be venting properly. Fig. 4 shows a sample data sheet which greatly facilitates the recording of these temperature data.

The equipment for taking room air temperatures both quickly and accurately is shown in detail in Fig. 5. A telescoping portable wooden standard supporting four thermometers at four different elevations, namely, 3 in. above the floor or "floor line," 30 in. above the floor or the new "comfort line," 60 in. above the floor or the usual "breathing line," and 3 in. below the ceiling, or "ceiling line," was used. This standard is adjustable in length, one section sliding inside of metal bands attached to the other section, and is held at any desired length by a thumb screw arrangement which clamps the two sections together. The lower section supports three of the thermometers in *permanent relative positions,* and the upper section, which slides up and down, supports the thermometer 3 in. below the ceilings. The standard is held in a vertical position at the center of the room by wedging it between the floor and ceiling. The ends of the standard are provided with large rubber headed tacks which take the thrust on the standard after it is in place. The thermometers are slipped through rubber stoppers which are held by common chemical test-tube clamps attached to the standard.

No attempt was made to protect the thermometers from or to correct for the slight effect of direct radia-

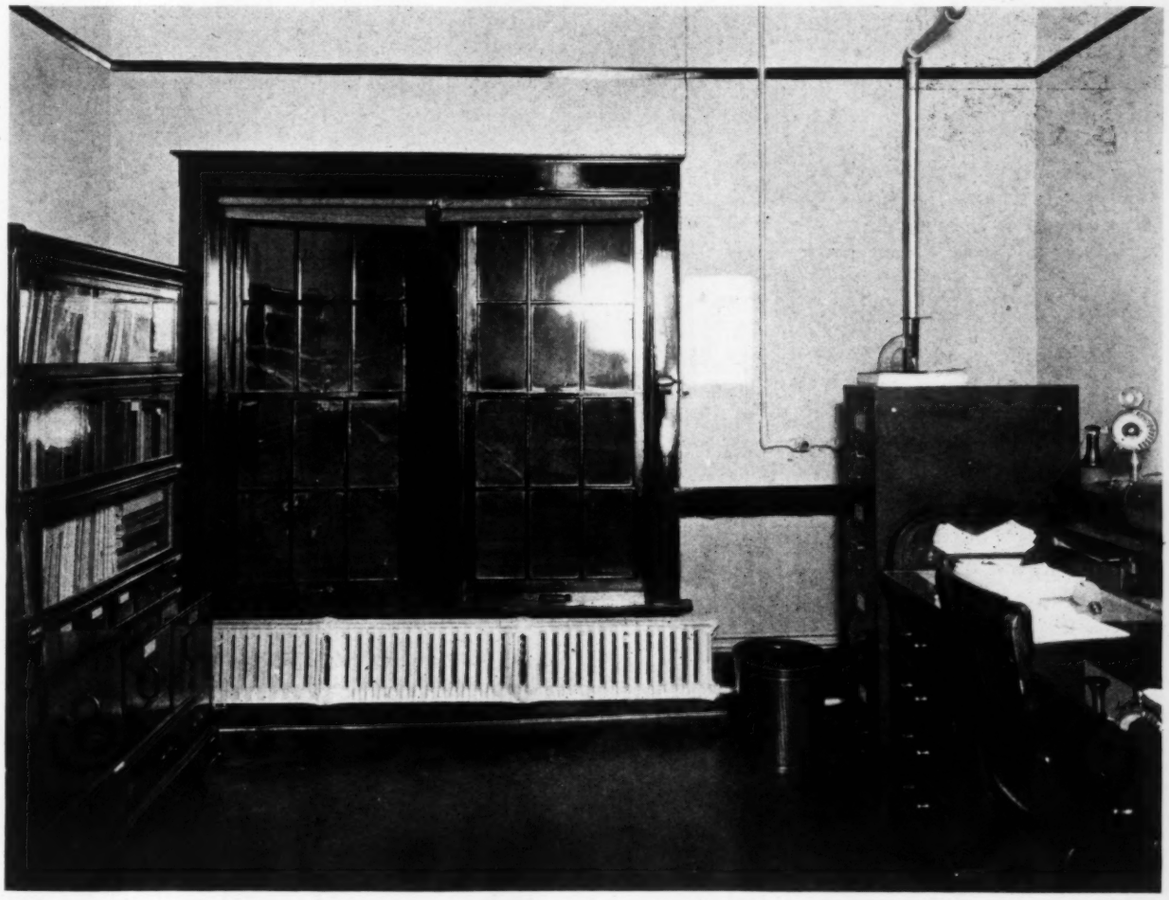


FIG. 2—THE WALL TYPE OF RADIATOR IN ROOM NO. 212

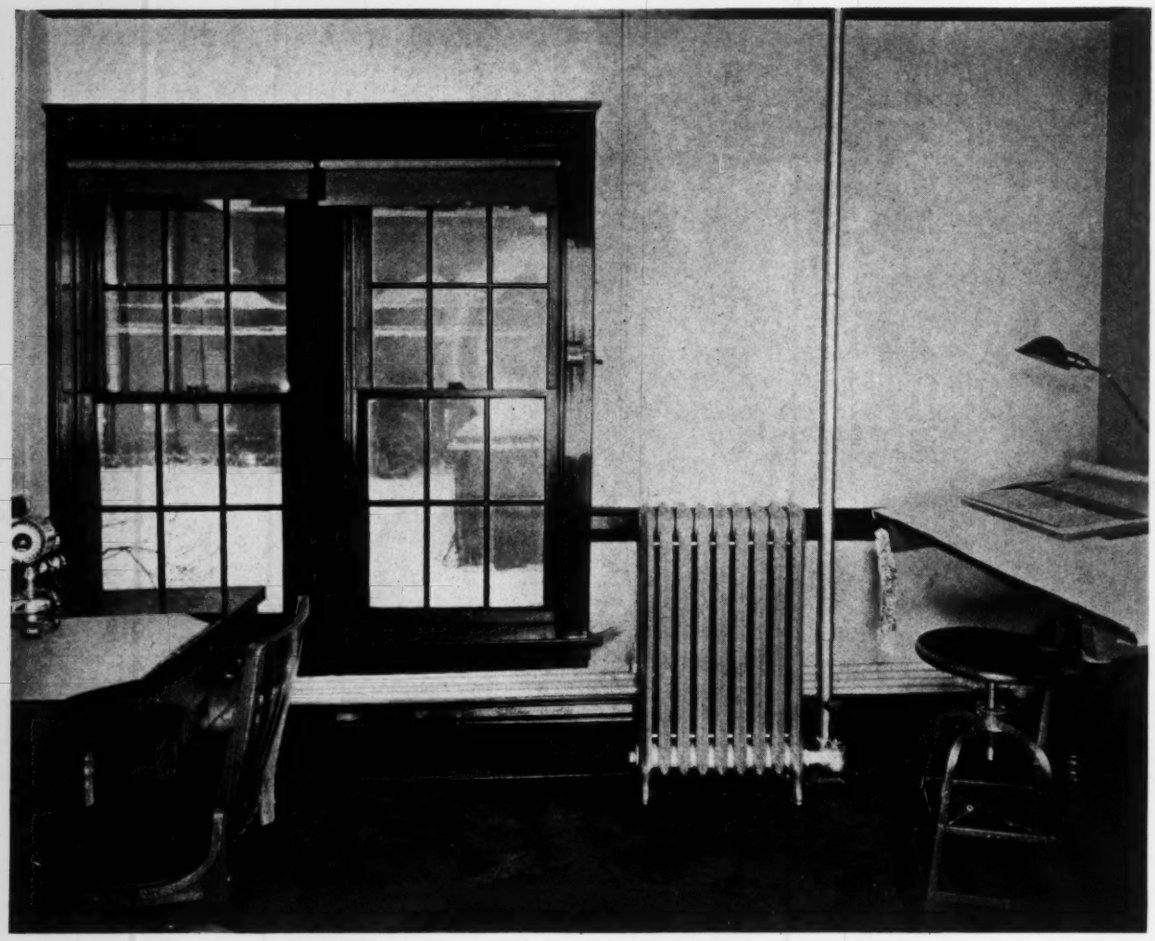


FIG. 3—THE COLUMN TYPE OF RADIATOR IN ROOM NO. 214

tion, since this effect is also experienced by the occupants and is one of the factors affecting comfort, the standards being located approximately at the center of the rooms and the minimum distance to any radiator was about 7 ft.

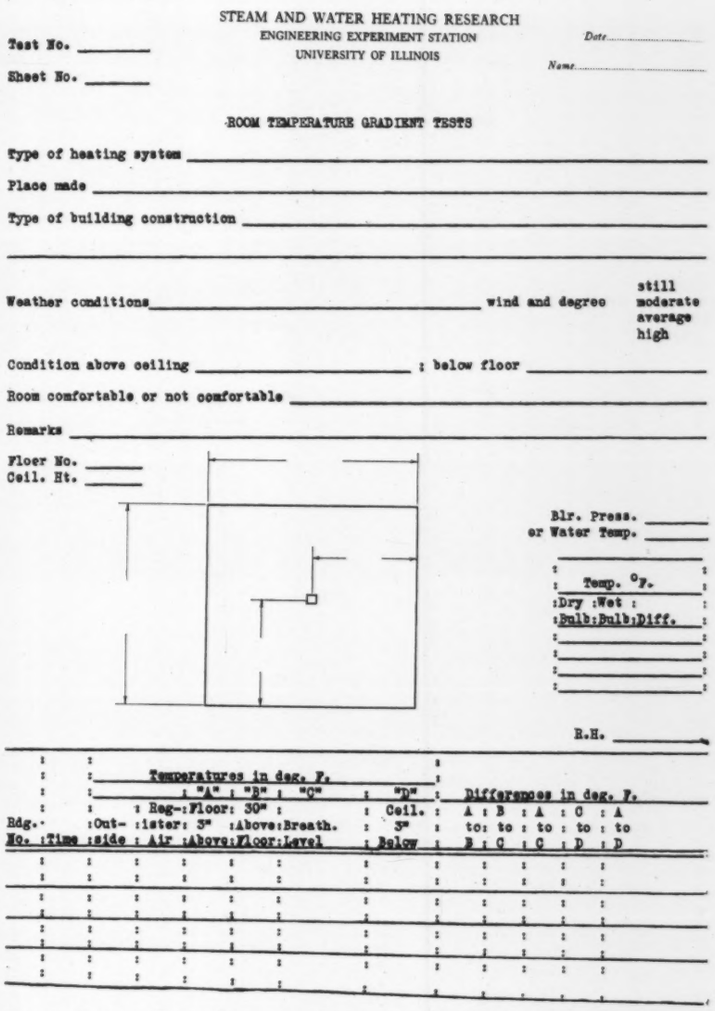
## Results

In discussing the results it must be kept clearly in mind that these two rooms have substantially the same amount of exposed wall and glass area, although room 212 has 78 sq. ft. or 50 per cent more ceiling area than room 214, and are both exposed to exactly the same outside and inside conditions except for the type and size of heating unit placed in the room. That the additional ceiling area in room 212 had no appreciable effect on differences in air temperatures between floor and ceiling was later proved by actually removing the column radiator and installing a wall type of radiator in room 214. When this was done room 214 showed air temperature differentials exactly similar to room 212.

The results are summarized in Table 1 and reference to the last column and Fig. 6 will show that room 212 with the long, low, narrow radiator had the smaller difference in air temperature between ceiling and floor, namely 1.5 F for an outside air temperature of + 8.3 F, and room 214 had the greater difference (ceiling to floor) in air temperature, namely 18.9 F for an outside air temperature of + 7.8 F. The "breathing line" temperatures in these two cases were 69.4 and 78.5 F respectively, the corresponding "floor line" temperatures were 69.6 and 67.6 F respectively, and room 214 was badly overheated, especially at the ceiling, which rose to 86.5 F, while in room 212 the ceiling temperature was only 71.1 F. It should also be noted that there was little change in these differences when the outside air temperature dropped to — 10 F, at which temperature room 212 showed a difference (ceiling to floor) of 1.4 F and room 214 showed a difference (ceiling to floor) of 18.5 F. The breathing line temperatures in the case with the sub-zero outside air temperature of — 10 F were 66.8 and 73.0 F respectively, and room 214 was distinctly not comfortable with an air temperature 3 in. above floor of 61.4 F while room 212 was quite comfortable with an air temperature 3 in. above floor of 66.6 F. Also note that the uncomfortable room 214 maintained an air temperature 3 in. below ceiling of 79.9 or 18.5 F higher than at the floor, while the comfortable room 212 maintained an air temperature 3 in. below ceiling of 68 F or only 1.4 F higher than at the floor.

It is now possible to point out that the heat losses from these two rooms are determined not merely on the basis of the area of the heat losing surfaces in walls, glass, and ceiling, as is generally assumed, but the heat losses are also decidedly affected by the type and location of radiators installed and the resulting effect on the air temperatures in the room. For example, the ceiling of room 212 is 50 per cent larger than the ceiling of room

214, yet the average heat loss through the ceiling of the former room with the low wall radiator is 234 sq. ft. $\times$ 0.525 (coef.) $\times$ (69.6° — 32.5°) = 4560 B.tu per hr. as compared with 156 sq. ft. $\times$ 0.525 (coef.) $\times$ (83.2° — 32.5°) = 4150 B.tu per hr. for the latter room with the high column radiator, or $\frac{410}{4150} \times 100 = 9.9$ per cent more. The average air temperatures from floor to ceiling line are 68.5 F for room 212 and 73.2 F for room 214, which on the common basis of an average outside temperature (Table 1) of — 0.9 F reduces the wall and glass heat loss and the infiltration heat equivalent for the former room to $\frac{4.7°}{73.2°} \times 100 = 6.4$ per cent less than the latter room. Since the calculated wall and glass heat loss and the infiltration heat equivalent of room 214 are 1870 (for wall) + 2380 (for glass) + 1705 (for infiltration) = 5955 B.tu, this 6.4 per cent reduction in air temperature difference through the wall and glass practically offsets (0.064 $\times$ 5955 = 381 B.tu as against 410 B.tu) the slightly greater ceiling loss (9.9 per cent) of room 212 and we find the two rooms require about the same amount of equivalent (240 B.tu per sq. ft.) radiation to maintain approximately the same "comfort line" temperatures of 68.0 F for room 212 and 69.1 F for room 214, although the former has decidedly more heat losing surface. Note, however, the *actual radiation* was only 27 sq. ft. in room 212 as against 36 sq. ft. in room 214.


STEAM AND WATER HEATING RESEARCH
ENGINEERING EXPERIMENT STATION
UNIVERSITY OF ILLINOIS

Test No. _____ Date _____
Sheet No. _____ Name _____

ROOM TEMPERATURE GRADIENT TESTS

Type of heating system _____
Place made _____
Type of building construction _____
_____
Weather conditions _____ wind and degree still moderate average high
Condition above ceiling _____ : below floor _____
Room comfortable or not comfortable _____
Remarks _____

Floor No. _____
Ceil. Ht. _____

Blr. Press. _____
or Water Temp. _____

| | | Temp. °F. | |
|---|---|---|---|
| | | Dry Bulb | Wet Bulb |
| | | | |
| | | | |
| | | | |
| | | | |

R.H. _____

| Bdg. No. | Time | Outside Air | Temperatures in deg. F. "A" Register: 3" Above Floor | "B" Floor: 30" Above Floor | "C" Breath. Level | "D" Ceil. 3" Below | Differences in deg. F. A to B | A to C | A to D | B to C | B to D |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

FIG. 4—SAMPLE DATA SHEET FOR RECORDING AIR TEMPERATURE STUDIES IN HEATED ROOMS

Room 214 was cold to occupants but at the same time *actually seriously overheated,* having an excessive heat loss through the ceiling. Room 212, with a 50 per cent greater cold ceiling area than room 214, was comfortable to occupants, and even after allowing for the higher rate of heat emission per sq. ft. of the wall type radiator in this room as compared with the column type radiator in room 214, actually required no

TABLE 1—DATA ON ROOMS, RADIATORS, AND AIR TEMPERATURES

| Date | Room No. | Size of Room: Length | Size of Room: Width | Type of Radiator | Nominal Area of Radiator Sq. Ft. | Location of Radiator | Air Temperatures, F: Outside: Average for 24-hr. previous to Test | Air Temperatures, F: Outside: At Time of Test | "Floor Line," 3" above Floor | "Comfort Line," 30" above Floor | "Breath. Line," 60" above Floor | "Ceiling Line," 3" below Ceiling | Air Temperature Differences, F: "Floor Line" to "Comfort Line" | "Comfort Line" to "Breath. Line" | "Breath Line" to "Ceiling Line" | "Floor Line" to "Breath. Line" | "Floor Line" to "Ceiling Line" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-16-30 | 212 | 19′-6″ | 12′-0″ | Wall | 27.0 | Under Window | +12.1 | + 8.3 | 69.6 | 69.9 | 69.4 | 71.1 | 0.3 | — 0.5 | 1.7 | — 0.2 | 1.5 |
| 1-22-30 | 212 | 19′-6″ | 12′-0″ | Wall | 27.0 | Under Window | — 0.9 | −10.0 | 66.6 | 66.0 | 66.8 | 68.0 | — 0.6 | 0.8 | 1.2 | 0.2 | 1.4 |
| Average | 212 | 19′-6″ | 12′-0″ | Wall | 27.0 | Under Window | ..... | — 0.9 | 68.1 | 68.0 | 68.1 | 69.6 | −0.15 | 0.15 | 1.45 | 0.0 | 1.45 |
| 1-16-30 | 214 | 13′-0″ | 12′-0″ | 38″, 2 Col. | 36.0 | Beside Window | +12.1 | + 7.8 | 67.6 | 71.9 | 78.5 | 86.5 | 4.3 | 6.6 | 8.0 | 10.9 | 18.9 |
| 1-22-30 | 214 | 13′-0″ | 12′-0″ | 38″, 2 Col. | 36.0 | Beside Window | — 0.9 | — 9.5 | 61.4 | 66.2 | 73.0 | 79.9 | 4.8 | 6.8 | 6.9 | 11.6 | 18.5 |
| Average | 214 | 13′-0″ | 12′-0″ | 38″, 2 Col. | 36.0 | Beside Window | ..... | — 0.9 | 64.5 | 69.1 | 75.8 | 83.2 | 4.55 | 6.7 | 7.45 | 11.25 | 18.7 |
| 1-23-30 | 214 | 13′-0″ | 12′-0″ | Wall | 21.0 | Under Window | + 1.0 | + 4.3 | 65.5 | 66.8 | 67.4 | 67.7 | 1.3 | 0.6 | 0.3 | 1.9 | 2.2 |

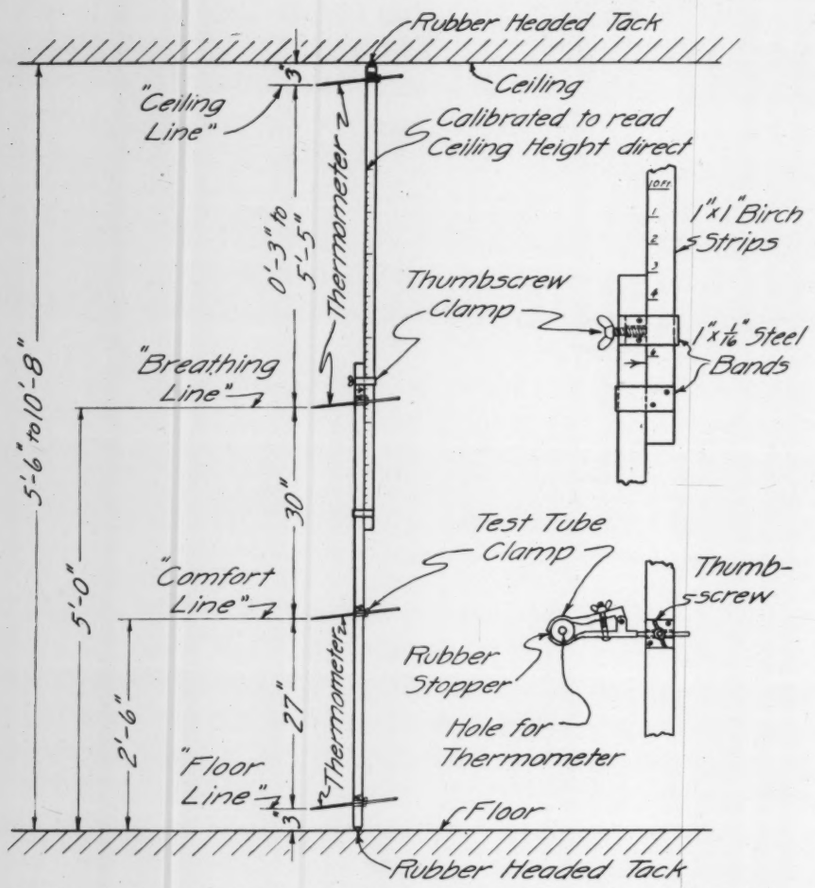



FIG. 5—PORTABLE STANDARD FOR SUPPORTING THERMOMETERS USED IN DETERMINING "HEATING EFFECT" IN ROOMS

more steam to make it comfortable than room 214 with the 38 in. high, 2-column radiator.

The validity of the above data was further checked by actually replacing the 36 sq. ft., 38-in. high, 2-column radiator in room 214 with a 21 sq. ft. wall radiator of three 7 sq. ft. sections placed under the window. This change in radiators in the same room presented a most striking example of the variation in floor to ceiling temperature differentials as affected by the type and location of radiators. Referring to Table 1 and Fig. 6, it may be seen that with the 36 sq. ft., 38-in. high, 2-column radiator in room 214 placed beside the window the average temperature differential between the floor and ceiling was 18.7 F with an average outside temperature of —0.9 F. This column radiator was then replaced with the 21 sq. ft. wall radiator of three 7 ft. sections placed under the window. The floor to ceiling temperature differential with this type of radiator placed directly beneath the window was 2.2 F with an average outside temperature of + 4.3 F and this value checks very closely with the average temperature differential of 1.45 F in room 212 which was also heated with a wall type of radiator placed directly beneath the window. This is a reduction of 16.5 F in the floor to ceiling temperature differential which existed with the higher column radiator.

In Table 1 and Fig. 6, it may also be seen that the large difference in the temperature differential obtained with the two types of radiators resulted from the reduction in the ceiling temperatures maintained by the wall type of radiator. With the average floor temperature 1.0 F higher with the low wall type of radiator than with the high column type, the ceiling temperature was 15.5 F lower, having been reduced from an average temperature of 83.2 to 67.7 F. The wall type of

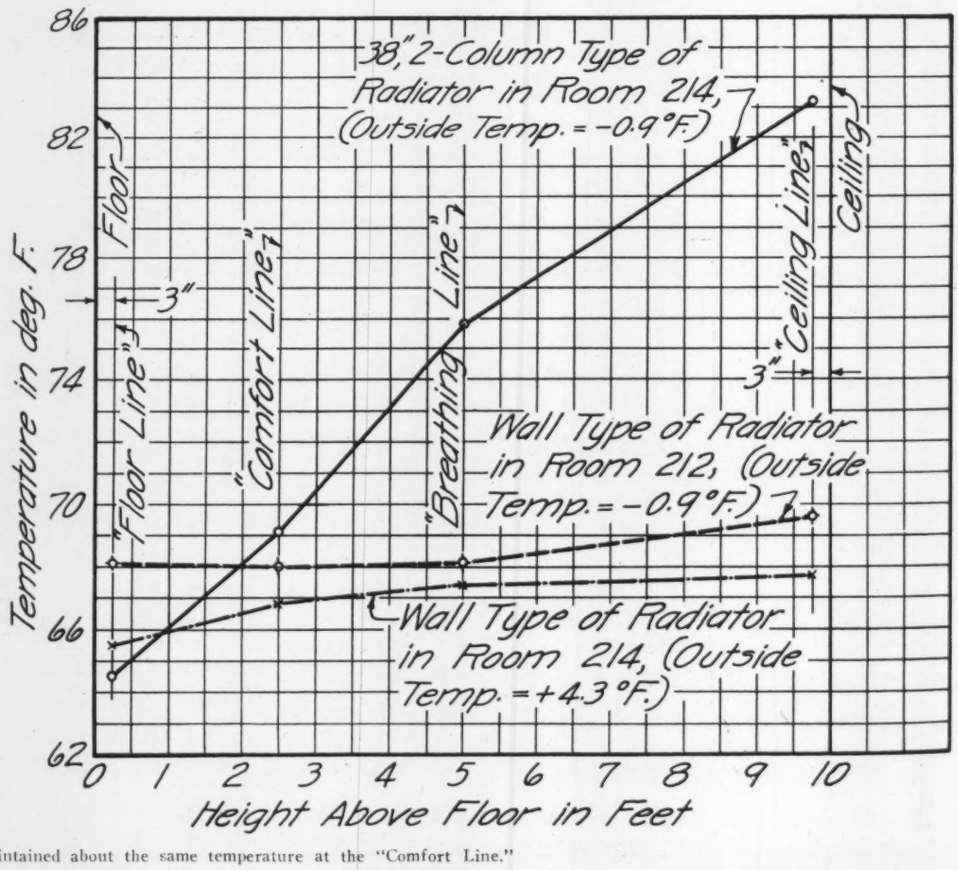



FIG. 6—AIR TEMPERATURE GRADIENTS* FROM FLOOR TO CEILING FOR COLUMN AND WALL TYPE RADIATORS

*Note that all three radiators maintained about the same temperature at the "Comfort Line."

radiator, therefore, not only heated the room more comfortably, but also more economically, as the heat loss through the ceiling was materially reduced.

A further illustration of the difference in the performance of the two types of radiators may be obtained by comparing the equivalent rated areas of each radiator. The nominal area of the high column radiator in room 214 is 36.0 sq. ft. and that of the low wall radiator in the same room is 21.0 sq. ft. The coefficient of heat transmission is approximately 27 per cent larger for the wall radiator than for the high column radiator. The area of the additional pipe necessary to install the wall radiator was 1.3 sq. ft. The total nominal area of the wall radiator expressed as equivalent column radiation becomes $(21.0 + 1.3) \times 1.27 = 28.3$ sq. ft. Comparing this area of 28.3 sq. ft. with the original nominal area of 36.0 sq. ft. of the column radiator, it may be seen that the reduction in "equivalent" radiation installed was 7.7 sq. ft. or 21.4 per cent, *but the actual reduction was from 36.0 to 22.3, or 13.7 sq. ft., or 38 per cent. At least 1/3 less cast iron was required,* based on the same unit weight of 7 lb. per sq. ft. of area for each radiator.

### Conclusions

The following conclusions may be drawn from the data given:

1. The steam condensation of a direct cast-iron radiator expressed in pounds of condensate is not an adequate measure of the performance of the radiator. The "heating effect" produced on the air in the room must be taken into consideration in making comparisons between different types of radiators.
2. Long, low cast-iron radiators placed under windows heat a room more comfortably and more economically than higher column radiators placed at the side of the windows.
3. Long, low cast-iron radiators maintain materially better floor to ceiling temperature differentials than high column radiators.
4. The larger portion of the temperature differential in a room heated with direct steam cast-iron radiators of the column and tubular types occurs between the floor and the breathing level.
5. The temperature used as an indication of whether a room is properly heated or not should be taken at some level nearer the floor than the breathing level.

### A Recommendation

If the results from this entire investigation[5] of room heating indicate anything, they indicate that air temperatures taken solely at the 5 ft. 0 in. level or "breathing line" in a room are a very poor index of the effectiveness of the heating unit in the room for maintaining satisfactory temperatures at the 2 ft. 6 in. level or "comfort line," as it may well be called. Unquestionably, both "breathing" and "comfort" line temperatures should be taken into account and it also appears probable *that the system which for a given "breathing line" temperature will maintain the highest "comfort line" temperature is the best.* From data now available, it is almost certain such a system will also require the least heat input into the room.

[5] See also "Investigation of Heating Rooms with Direct Steam Radiators Equipped with Enclosures and Shields," by A. C. Willard, A. P. Kratz, M. K. Fahnestock and S. Konzo, University of Illinois Engineering Experiment Station Bulletin No. 192, and "Investigation of Warm-Air Furnaces and Heating Systems," by A. C. Willard, A. P. Kratz, and V. S. Day, University of Illinois Engineering Experiment Station Bulletin No. 189.

## The Canal Bank & Trust Company Building, New Orleans

The Canal Bank and Trust building of New Orleans, La., is window ventilated with the banking space on the first floor and the vault in the basement ventilated by means of fans of 28,500 c.f.m., 13,200 c.f.m., 13,200 c.f.m. and 3,700 c.f.m. capacity, the two latter quantities referring to exhaust fans.

The air is not cooled in summer. The heat in winter is provided by two 250 hp. boilers operating at 100 lb. pressure and using fuel oil burners equipped with steam atomizers.

Circulating ice water in each office is provided by $CO_2$ machines, one of 20-ton and one of 12-ton capacity, using two pumps of 1,200 g.p.m. capacity each.

### 1,200 Lb., 825 F Steam at State Line

The second section of the State Line station, on Lake Michigan at the Indiana-Illinois boundary, will use steam at 1,200 lb. pressure and at 825 F. The station was first put into operation last summer, the first unit using steam at 650 lb. and 730 F with reheat at 71 lb. and 500 F. The addition is to be completed some time in 1932, according to present plans.

# Piping—Where Reliability and Compactness are Essential

FIG. 1—A MODERN SUBMARINE AT SEA

A RECENT visitor aboard a submarine under overhaul at the Navy Yard, Portsmouth, N. H., asked the officer who was showing him through the vessel, "How in the world do you people learn to handle the million and one valves in this ship?"

The answer was, "Because we live with and by them. In fact, I am on the most intimate terms with a main ballast tank emergency vent valve which overhangs and practically shares my bunk."

It is not surprising that the several miles of piping and multiplicity of valves which must be crowded into the restricted space available in submarines for the control of these vessels should appear to a casual visitor to be a hopeless maze. The submarine officer's reference to his bunk-mate indicates how restricted this space is.

## Functions of Systems

Piping systems in submarines are required for handling compressed air, salt water, fresh water, fuel oil, lubricating oil, oil in hydraulic power systems, oxygen, carbon dioxide, gasoline, air for ventilation, and, in some of our latest submarines, steam.

The compressed air system is fitted primarily for blowing water out of the ship's ballast tanks when it is desired to bring the vessel to the surface. It also serves certain auxiliary purposes which include salvage, the blowing of sanitary tanks, and the operation of water closets, whistle, siren, electrical switches, diving alarms, and fresh water pumps. A compressed air system is also required for starting the Diesel engines and for supplying spray air to these engines.

Salt water systems are installed to handle trimming water through the submarine in order to control balance, for flooding and pumping the auxiliary ballast tanks in order to control buoyancy, for ordinary drainage of the several compartments, for handling large quantities of water which may enter a damaged compartment, and for supplying cooling water to the engines and refrigerating machinery and feed water to the evaporators.

The fresh water system serves the galley, scullery, drinking fountains, pantries, lavatories and showers.

Fuel oil and lubricating oil piping systems are installed to serve the Diesel engines which furnish the motive power in normal surface operation.

The installation of hydraulic steering gears and hydraulically-operated anchor windlasses in some submarines involves the provision of piping to handle the light lubricating oil which is the pressure medium used in these systems.

Arrangements are provided for supplying oxygen to all the principal compartments of a submarine when the vessel is submerged for the purpose of making up oxygen lost due to the breathing of the crew during extended submerged operation and to manifolds at escape positions for charging escape appliances.

Ship's ventilation, battery ventilation, and motor ventilation piping adds its bulk to the volume of piping for which space must somehow be found.

Certain minor systems of piping claim their quotas of weight and space. These systems include built-in carbon dioxide fire extinguishing systems, voice tubes, gasoline stowage systems for handling gasoline for the submarine's small boats, and pressure greasing distribution systems for the lubrication of outboard auxiliaries from within the vessel.

## General Considerations of Design

With the heavy premiums on weight and space which obtain in submarine construction, it is essential that the

*By* E. W. Sylvester, Lt. (C. C.), U. S. N.

greatest care and thought be given to the layout and detail design of the extensive piping systems. This problem is attacked on the general basis of selecting from those materials which it is practicable to use for a given purpose that material which possesses the highest modulus of elasticity, the use of the maximum fluid velocities possible under the condition of satisfactory operation, and the reduction in size and weight of valves, manifolds, and fittings by careful attention to the detailed design of these parts.

### Materials of Piping

The following notes cover briefly the present practice in the selection of materials for the piping of the various systems.

Compressed air piping is either seamless drawn brass or seamless drawn copper tubing. Some experimental work has been undertaken with a view toward studying the possibilities of using corrosion-resisting steel tubing in these systems. The seamless drawn brass tubing is used in compressed air systems in which the working pressures are above 450 lb. per sq. in.; the use of this material represents a very considerable saving in weight. Seamless copper tubing is used in low pressure compressed air systems. No appreciable saving in weight would result from the use of brass tubing in these low pressure systems, as, under present specifications for brass and copper tubing for these pressures, the wall thicknesses for brass and copper are practically the same. Consequently, the superior workability of copper indicates its use for this duty.

The material for brass tubing now used for working pressures between 450 lb. per sq. in. and 4,000 lb. per sq. in. is an 85-15 brass for which Navy Department specifications have recently been issued. The following composition of this material is specified:

| Copper (per cent) | Lead (Max.) (per cent) | Iron (Max.) (per cent) | Zinc (per cent) |
|---|---|---|---|
| 83-86 | 0.20 | 0.05 | Remainder |

Thicknesses of this tubing are specified on the basis that the stress shall not exceed 10,000 lb. per sq. in. in the formula:

$$t = D/2\ (1 - \sqrt{(S-P)/(S+P)})$$ where

$t$ is wall thickness in inches
$P$ is working pressure in lb. per sq. in.
$D$ is outside diam. in inches
$S$ is stress in lb. per sq. in.

This brass tubing is furnished semi-annealed and the following physical properties are specified: a minimum tensile strength of 35,000 lb. per sq. in. and an elongation of 30 per cent in eight inches.

Navy department specifications covering seamless drawn copper tubing require a purity of at least 99.88 per cent as determined by electrolytic assay (silver being counted as copper), a minimum tensile strength of 30,000 lb. per sq. in. after being annealed and an elongation of at least 25 per cent in eight inches.

Salt water piping, with the exception of certain drainage lines and engine circulating water systems, is seamless copper tubing. The selection of copper for this service rests on the same considerations mentioned above as governing the use of copper tubing for low pressure

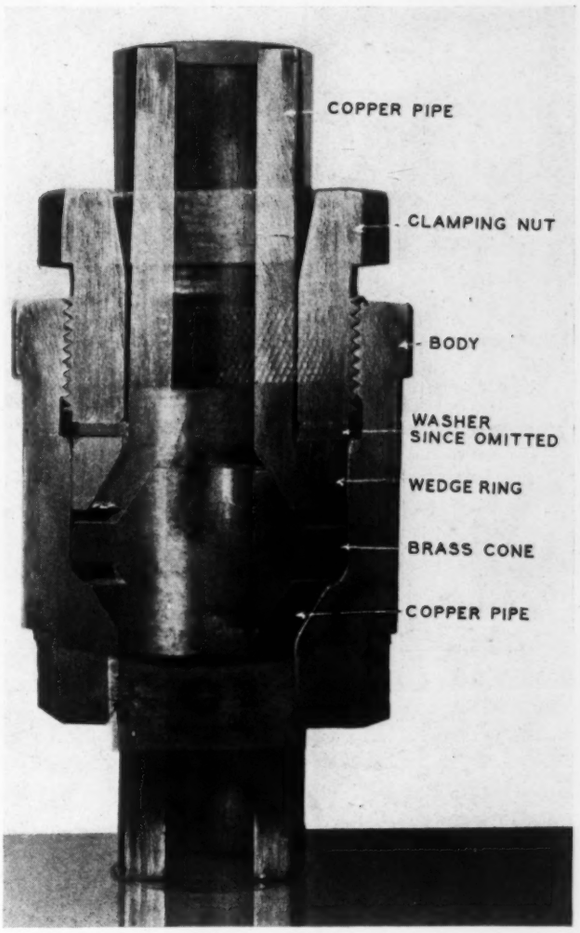



Fig. 3—Double Cone Connection Used for Copper and Brass Submarine Piping

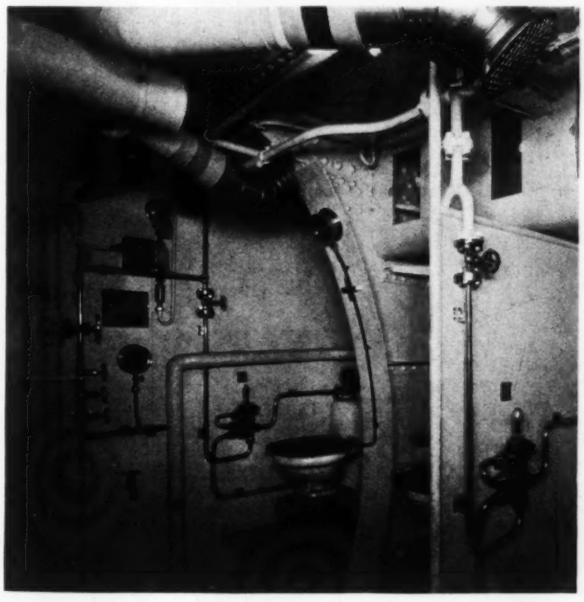


Fig. 2—Many Feet of Piping Must Be Crowded Into the Restricted Space Available in Submarines

FIG. 4—SLEEVE COUPLING ON .840-.065 COPPER TUBING TESTED TO 4,800 LB.

compressed air systems. The piping in certain drainage systems installed for freeing the vessel of large quantities of water in case of damage, in which systems the piping is of large diameter and must withstand heavy external collapsing pressures, is galvanized steel. Engine circulating water piping is 85-15 brass tubing.

Fresh water systems are piped with galvanized steel and brass pipe, galvanized steel being used except for those lines which carry potable water and for lines in locations where appearance is a consideration, for which lines brass pipe is used. Battery water systems are exclusively brass to eliminate the possibility of rust entering and damaging the batteries. Battery water is carried in lead-lined or sheet nickel tanks for this same reason.

Submarine fuel oil systems are of the so-called "compensating" type. In such systems, fuel oil used from the system is replaced by sea water in order that the displacement and fore and aft balance of the vessel may be kept approximately the same at all times in order that such adjustments in weight and fore and aft moment as may be necessary, as a result of using fuel oil, to bring the vessel into diving trim will be within the capacity of the variable ballast tanks fitted for the purpose of making these adjustments. Consequently, a large proportion of the piping in submarine fuel oil systems is subjected alternately to fuel oil and salt water. For that part of the fuel oil system which is not a part of the compensating system, galvanized steel piping is used. For piping forming a part of the compensating system seamless drawn copper tubing is employed. Small size fuel and lubricating oil lines attached to engines are made of steel on later types of engines.

Hydraulic steering gear and anchor windless power systems are, in general, piped with seamless brass tubing. Some application of seamless drawn steel tubing has been made in these systems.

Extra heavy steel pipe is used in carbon dioxide fire extinguishing systems on account of the high pressures to which these systems are subjected when carbon dioxide is released into them from the flasks in which it is carried.

### Oxygen Piping

Oxygen piping is subject to the conditions most favorable to corrosion. Also, pressures in oxygen systems are high, the pipe sizes are small and the leads are tortuous. What saving in weight would result from the use of brass in these systems is considered not great enough to warrant sacrificing the installation advantages afforded by the workability of copper tubing. On this same basis of small size and tortuous leads, copper tubing is used for gage lines in all systems.

Pressure lubrication distribution systems are subjected to high internal grease pressures and to the corrosive effect of sea water where these systems are installed for the lubrication of outboard auxiliaries. They are of brass tubing.

### Ventilation Pipe and Ducts

Battery ventilation piping, which is subjected to the corrosive action of acid fumes, is of molded rubber in the vicinity of the batteries and of welded monel ducts in other locations.

Ship's ventilation ducts are usually built up of galvanized sheet steel. Some use of welded monel metal construction has been made in these systems in the vicinity of outboard connections.

### Valves and Manifolds

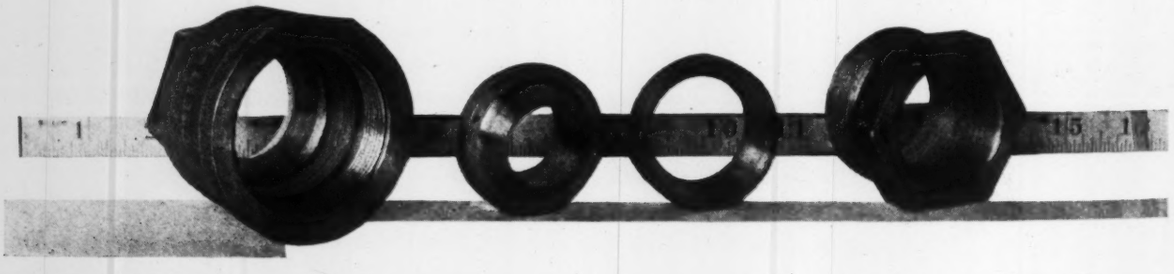
The present general practice in the manufacture of valves and manifolds and pressure castings of all kinds is to use gunmetal for these parts in all cases where the working pressures are in excess of 100 lb. per sq. in. and especially for such parts as are subjected to shock, water hammer or the like. This tough 88, 8, and 4 per cent mixture of copper, tin, and zinc with a minimum tensile strength of 40,000 lb. per sq. in. is eminently suitable for this service. A valve bronze which has a tensile strength of 32,000 lb. per sq. in. and of the following composition is used for valves and miscellaneous fittings for working pressures below 100 lb. per sq. in.

| Copper (per cent) | Tin (per cent) | Zinc (per cent) | Lead (per cent) |
|---|---|---|---|
| 88 | 6.5 | 4 | 1.5 |

Nickel bronze castings and monel metal forgings are employed in the manufacture of certain special valves and manifolds subject to very high working pressures.

Some application has been made of a 0.75 per cent nickel cast iron for valves and bodies of piston type

FIG. 5—EXPLODED VIEW OF ONE-INCH DOUBLE CONE CONNECTION USED FOR COPPER AND BRASS PIPING. FROM LEFT TO RIGHT ARE THE BODY, CONE, WEDGE RING, AND NUT



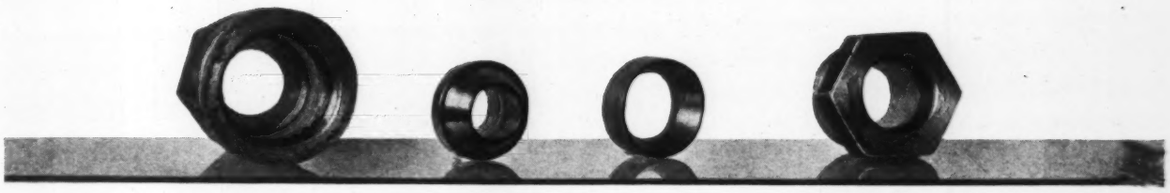


FIG. 6—THE ONE-HALF-INCH DOUBLE CONE CONNECTION USED FOR COPPER AND BRASS PIPING

control valves in hydraulic power systems. The present tendency, however, is toward the use of cast steel for these parts.

### Connections

Flange connections are used for all piping over two and a half inches. Below two and a half inches, the connections used depend upon the service and material of the piping and are either screwed pipe unions, flanges, cone joints or sleeve couplings. Composition flanges are used on copper and brass piping. They are assembled on the pipe by peening the end of the pipe over a recess in the face of the flange and brazing the pipe to the flange.

Steel flanges are welded to steel pipe. The pipe is pushed through the flange just short of the face of the flange and the end of the pipe is welded to the inside of the bore of the flange and the back of the flange is welded to the outside of the pipe. This method of assembly has the disadvantage of increasing the pressure area on the flange by the cross sectional area of the pipe wall. A method of assembly to overcome this disadvantage has been developed. This latter method is to bevel the bore in the face of a rough machined flange, to enter the pipe through it until the end of the pipe is slightly beyond the face of the flange, to secure the pipe by welding in the bevel in the bore of the flange, and then to finish machine the face of the flange by the use of a facing head. For this facing operation, the flange is held in a vise especially designed to provide for expeditious handling and automatic centering in the facing machine. Practically all submarine flanges are now the so-called "stepped" or reinforced type.

The cone type union used for connecting brass and copper pipe and tubing is illustrated in Fig. 3. This connection has the advantage of taking up less space than a flange connection and provides for relatively easy disassembly and reassembly.

Sleeve couplings are used in brass and copper piping to a certain extent in straight runs of piping in locations where it is unlikely that piping will have to be removed in connection with the periodic overhaul of machinery. These sleeves are made of naval brass. They are three times the diameter of the pipe in length, one and one-half times the thickness of the pipe in wall thickness, and have internal diameters two-thousandths greater than the outside diameter of the pipe they are used with.

These sleeve couplings are made up as follows: the two pipe ends to be connected and the inside of the sleeve are tinned. The sleeve is heated and slipped over one pipe end, the two ends brought together and the sleeve centered over the butt. Cooling of the sleeve results in a tight joint. A greater difference than two-thousandths between the inside diameter of the sleeve and the outside diameter of the pipe is not used because such greater difference involves the addition of solder to the joint to make it tight and such addition of solder introduces the likelihood of constricting the cross-sectional area of the pipe by solder finding its way into the pipe through the butt.

The use of such sleeves would not appear at first glance to be practical as the two-thousandths clearance is less than the allowable tolerances on outside diameter of most sizes of pipe and tubing. It so happens, however, that the outside diameters of the individual tubes of a given size of tubing received on a single contract do not usually vary within the lot as much as two-thousandths. Consequently, on new construction, sleeves for each size of tubing can be stocked bored undersize, and reamed to suit the outside diameter of the lot of tubing of that size which is being installed.

### Reliability Paramount

The fundamental consideration in the design of submarine piping systems must be and is absolute reliability. Important as are the factors of weight and space, no concessions can be made, in submarine construction, to these old enemies of the marine engineer and the naval architect at the expense of safety.

---

## Leak Indicators and Meters*

There are several types of instruments available for detecting leaks underground; some are of the ordinary stethoscope type with ear tubes and some are electrically operated. The United States government has a pamphlet, distributed free, describing a device called a "geophone."

When men become familiar with sounds of leaks for various kinds of underground piping, it is surprising how accurately they can be detected. The cost of the instruments is small and will aid considerably in the prevention of line losses, which means a saving in fuel. Knocks in power plant machinery can readily be located and various other uses made of the instrument.

### Meters

The metering of the steam used by the different facilities should receive careful consideration when designing or redesigning the power plant. For small plants supplying yards with steam, displacement or disc type water meters installed in the water service lines for the plant are often used, and give accurate enough readings for most plants. Two or three of these meters can be installed in multiple, and the operating force can select meters according to the load on the plant. During mild weather, a small meter can be used, and during severe weather, when the requirements are greater, a larger meter can be used. It is also advisable to install flow meters on the service lines leaving the plant, which will be a check on the amount of steam used.

* This information was abstracted from a paper presented at the 1929 annual meeting of the International Railway Fuel Association.

# Dust Hazards and Profits

*By* H. C. Murphy

COMPETITIVE business conditions today are bringing home more than ever the necessity of eliminating wastes of material, time or money from manufacturing processes. Close competition years ago unquestionably forced the meat packers into a consideration of this subject and today they are said to make

FIG. 1—THE DUST COLLECTING SYSTEM IN THE PLANT OF ONE OF THE LARGEST MANUFACTURERS OF MEN'S BELTS IN THE COUNTRY MAKES EXCELLENT WORKING CONDITIONS POSSIBLE

a profit out of every part of the animal except the "squeal."

### New Plant Paid for

A few years ago a prominent manufacturer of gold and silverware paid the entire cost of moving into a new plant by the recovery of gold, silver and platinum dust from the exhaust air of his workshops—air which would otherwise have been "thrown away" and which would have constituted a menace to his employes and a nuisance to his neighbors. A moderate sized room filled with oil-soaked wood shavings constituted his "air filter." The exhaust air from his workshop was forced through this room, leaching out precious metals of no inconsiderable value. The shavings were periodically burned and the gold and silver recovered from the ashes. The process was of course open to certain obvious objections. It was messy, cumbersome, and constituted a certain fire hazard through the possibility of spontaneous combustion in the oil-soaked wood shavings. In his new plant he installed a commercial make of viscous, all-metal, air filters occupying much less space, eliminating the fire hazard, and greatly simplifying the process of dust recovery.

### Molasses Air Filter

Some years ago a forceful cereal mill executive sought to overcome the ever-present dust explosion hazard through an entirely original expedient. He thickly coated the entire side of a large room with molasses and forced the dusty air into contact with it. This pioneer of the now quite generally used principle of air filtration by adhesive impingement had, however, neglected to devise ways and means of cleaning his "filter," and this was found to be a most arduous and disagreeable task.

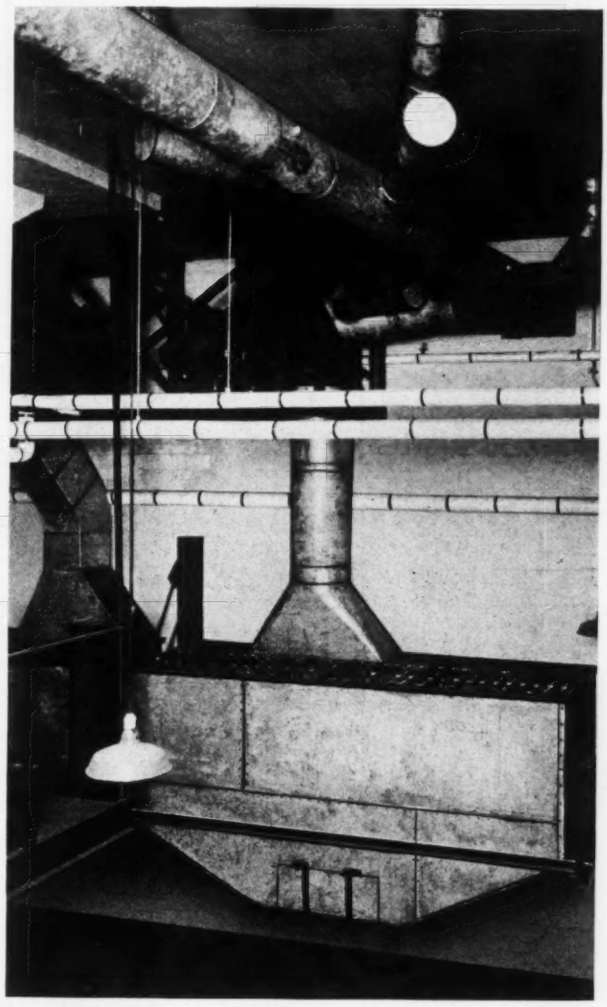
Modern air filters are usually of a convenient handling size, the media varying with different manufacturers and to meet different engineering requirements. It is possible, however, to secure commercial equipment to meet almost every demand.

### $2,800 Dividend on $500 Investment

A prominent fountain pen manufacturer who installed an air filter for dust recovery about two years ago reports that he recently burned a year's accumulation of filter sheets and recovered $2,800.00 in precious metals. When it is understood that the first cost of this air filtering apparatus was in the neighborhood of $500.00, the desirability of such economies is apparent. The air filter in question uses sheets of spruce-wood fiber, having the general appearance of rough textured paper. The filter leaches from the air particles of almost microscopic fineness, supplying clean, wholesome air, which is returned to the workrooms, saving heat in winter and effecting substantial economies every day in the year. It is perhaps significant that the owner placed more stress on the improved working conditions in his plant than

FIG. 2—DUST RECOVERY EQUIPMENT INSTALLED FOR HANDLING SOLID GOLD BUFFING IN A LARGE OPTICAL GOODS PLANT

FIG. 3—THIS SHOWS THE DUST ARRESTER INSTALLED ON THE FLOOR BELOW THE ONE SHOWN IN FIG. 1. THIS HAS A CAPACITY OF 10,000 C. F. M.



upon the $2,800.00 dividend on a $500.00 investment. This factor, while difficult to measure in dollars and cents, is well appreciated by far-sighted employers.

One of the world's largest manufacturers of eye glasses, a concern famous for its manufacturing efficiencies, estimates that each sheet taken from the air filter after one month's use is worth $20.00. The installation takes dust from the buffing of gold frames for eye glasses. The cost of installation was repaid within a few months by the gold recovery from the filter. When dirty, the filter sheets are easily changed. The sheets can readily be folded up and put aside until a sufficient number is accumulated to warrant reduction and recovery of the gold.

While the recovery of precious metals is more spectacular than our hum-drum necessity of guarding against industrial wastes, the possible savings in manpower and materials by the use of commercially available dust removal and dust recovery equipment are of much importance. It is probable that the art of eliminating explosive hazards and poisonous dusts from manufacturing processes is a greater contribution to civilization than the recovery of precious metals.

## Government Ventilation Data

Two of the publications of the Bureau of Construction and Repair of the Navy Department which are of especial interest to ventilating engineers are "Weight of Air Tables" and "Specifications for Testing Ventilation Systems on Vessels of the United States Navy." Copies of each may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington. The first costs ten cents, and the second five cents.

The tables give the weight of air in pounds per cubic foot for dry bulb temperatures from 30 to 100 F and for barometric pressures ranging between 28.5 and 31.0 inches. The weights of saturated air are given directly, and the proper factors are given for computing the weight with various wet bulb depressions.

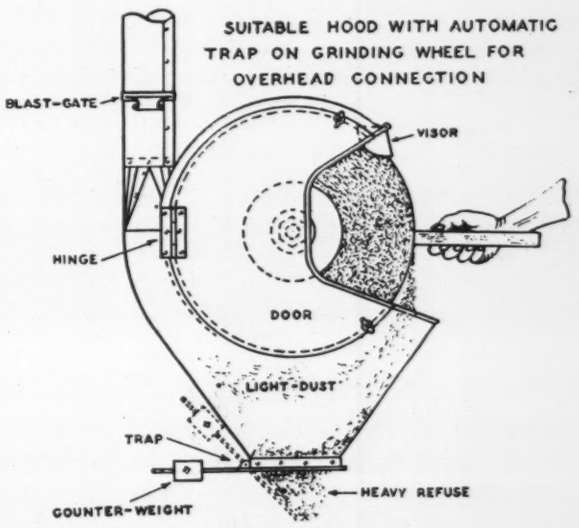
The specifications include directions for making electrical input tests, delivery tests, endurance and alternate tests, permissible variations, and instructions for correcting data obtained. Several numerical examples are included.

## Trap Aids in Dust Removal

BECAUSE of its weight, much of the dust generated in heavy grinding is not carried into the exhaust system. In dressing wheels, oil is sometimes used which, with the dust, forms a mud too heavy to be carried away by the exhaust.

Heavy dust driven into a hood will be found to settle and "cake," while the fine dust passes on and is removed by the exhaust.

Through inattention this heavy refuse is permitted to accumulate and harden until it piles up to a point where the opening into the exhaust pipe is obstructed or entirely cut off. For this reason hoods are sometimes provided with traps, in some cases extending to the floor to catch and trap the heavy refuse. This idea is all right as far as it goes, but where the refuse is not removed as it accumulates the trap fills up and becomes a solid mass that cannot be removed



except with a chisel bar, resulting in a badly battered hood.

To dispose of this heavy refuse and maintain the efficiency of the exhaust system, the illustration shows a suitable exhaust hood equipped with an automatic trap for grinding wheels where the connection to the main suction pipe is overhead. The trap is the principal feature, permitting the heavy refuse accumulating in the bottom of the hood to be dumped automatically.

In cleaning rooms of foundries with earth floors, or for any plant with earth floors for that matter, where the main suction pipe is overhead this type of hood is often used, according to information from the *New York State Department of Labor*. A bulletin states:

"Where this type of hood is used over wood, cement or other floors, a receptacle may be placed under the trap to receive the refuse. The inside shell of the hood should extend around the rear of the wheel below the hinge about 50 degrees from horizontal and there should be a small opening into the branch pipe at its junction with the hood."

## Preventing Escape of Material in Dust Form

THE escape of material in dust form while filling containers, such as bags, boxes, or barrels whether with finished or raw material, constitutes not only a waste, but in addition often creates a serious health hazard to the employes where the process is carried on.

The escape of material in the form of dust from any machine or device may be blown out of open windows, fall and accumulate upon the work-room floor, or settle upon walls, ceilings and ledges. This material must be swept up periodically, and the other places where the dust has found lodging must be cleaned, involving the expenditure of time and money.

The abrasive effect of dust upon the moving parts of machinery is well known and should be prevented. The distribution of dust can be lessened by using the proper kind of a device to minimize the escape of material while packing, boxing or barreling says a bulletin from the *Bureau of Industrial Hygiene* of the *New York State Department of Labor*. The illustrations below serve to illustrate the uneconomic and economic methods used in two plants.

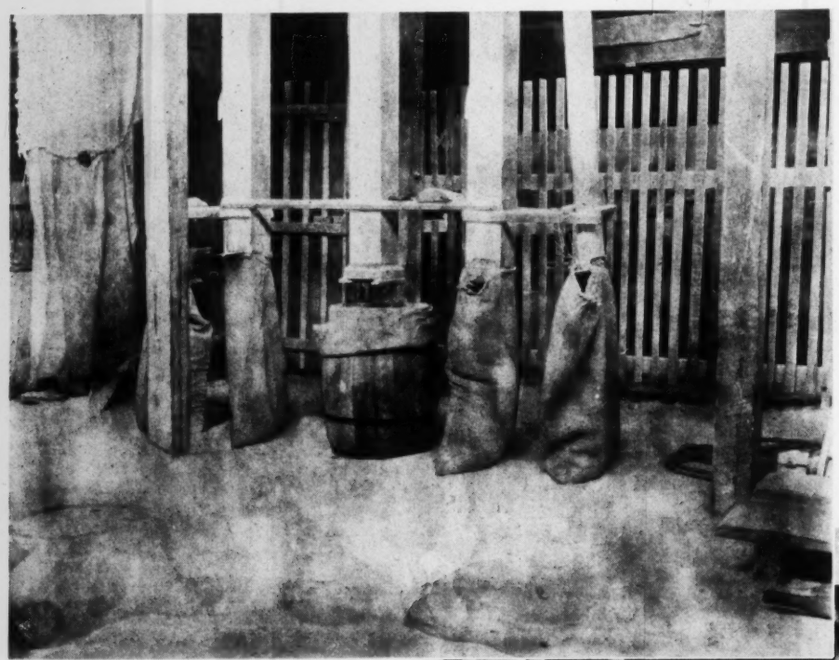


FIG. 1 — METHOD OF FILLING BAGS AND BARRELS WITH PULVERIZED PUMICE STONE, IN WHICH PROCESS A CONSIDERABLE QUANTITY OF VALUABLE SILICIOUS DUST ESCAPES INTO THE WORK-ROOM AIR. ECONOMY AND HEALTH HAVE BEEN DISREGARDED BY THE MANAGEMENT IN CONDUCTING THE OPERATION BY THIS MEANS

FIG. 2—A METHOD OF PREVENTING THE ESCAPE OF PULVERIZD PUMICE STONE WHILE BARRELING THE PRODUCT. THE BARRELS ARE PLACED IN AN ENCLOSURE, THROUGH THE TOP OF WHICH THE FEED PIPES FROM THE STORAGE HOPPERS DISCHARGE THE MATERIAL INTO THE BARRELS. THE FRONT PART OF THE ENCLOSURE IS PROVIDED WITH A MOVABLE, HEAVY DUCK CURTAIN. MECHANICAL EXHAUST IS PROVIDED TO REMOVE DUST AS IT RISES FROM THE BARRELS. THE DUST IS RECOVERED IN A COLLECTOR WHICH IS CONNECTED WITH THE EXHAUST SYSTEM

# Specifications for Heating and Ventilating

*By* Samuel R. Lewis

Article No. 1

PROBABLY there is no subject more shied at than that of specifications. Some engineers believe that there is something proprietary and sacred about their own particular brands of specifications, forgetting, apparently, that anyone who desires may borrow and copy them from any bidder.

We do not remember having seen, in print, a great deal on the subject of specifications. We have purchased everything that came along on the subject of heating and ventilating specifications but have not received any very heavy inspiration.

In the following outline are listed the major specification items in an average public building plant, and without attempting to go into too much detail I have suggested some of the questions which must be determined by the specifications, based upon my own experience.

### General Conditions

These usually refer to those of the architect of the building. The "General Conditions" of the *American Institute of Architects* are an excellent guide. Usually they may be referred to as governing jurisdiction for the heating and the ventilating contract. They should define the powers and duties of the various parties to the contract.

### Prorating General Expenses

On large contracts especially, there is sometimes complaint by the sub-contractors because of prorate charges for telephone, water and lights and use of elevator. This service is assuredly for the owner's benefit and the owner ultimately must pay for it. There seems to be no better way than for the general contractor to maintain these facilities and to charge them back, but the specifications always should cover the point so that all sub-contractors may include an item for it.

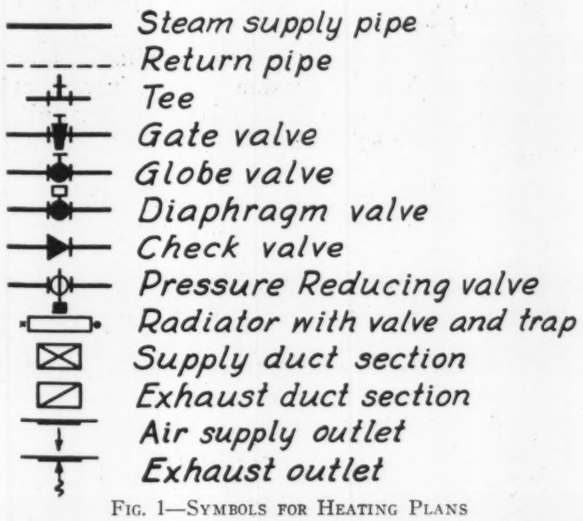



FIG. 1—SYMBOLS FOR HEATING PLANS

### Drawings and Symbols

The specifications usually are more effective if they list the basic contract drawings and if they describe the symbols for various appliances such as globe or gate valves, thermostats, traps, etc.

### Permits

In many cities and states, plans of the heating and ventilating system must be submitted to governing authorities, and fees must be paid. The specifications should define the responsibility for these matters.

### Bond

A bond usually is required on public building contracts, in the sum of the contract. It may require merely the completion of the contract, but it may involve also a guarantee that the contractor will pay all bills for material and labor. Such a bond generally costs 1½ per cent of the contract price.

### Insurance

Insurance against liability on account of injury to workmen or to the public and for fire, tornado, etc., should be required. Often the contractor carries employers' liability insurance, while the owner carries fire and tornado insurance.

The contractor should be required to file with the owner certificates from the insurance companies evidencing the policies.

An interesting recent legal decision has held that if one contractor make a scaffold which, through faulty construction, gives way and injures the workman of another contractor, the first contractor may be held liable, and in this case the ordinary compensation insurance did not help the first contractor, since it applied only to his own employes.

### Extent of Work

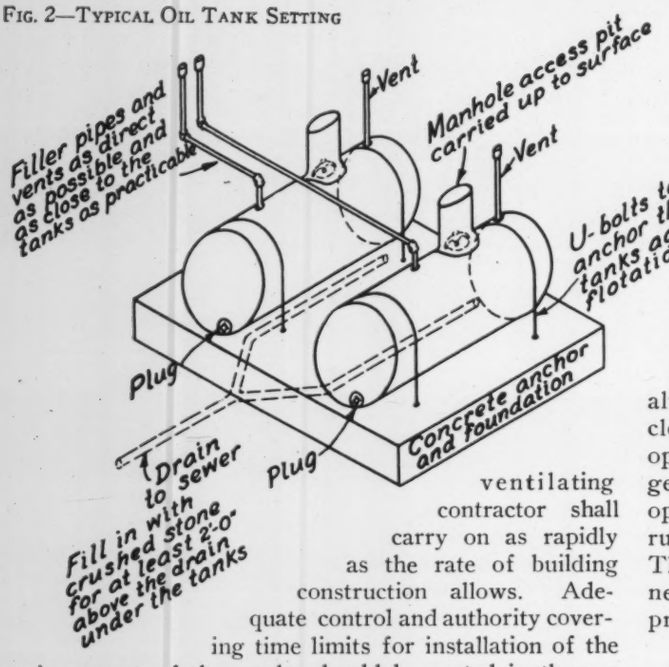
The extent of the work should be described, limiting the points where the contract begins and ends.

For instance, with district heating: Where does the contractor connect with the service lines, who furnishes valves, separators, traps, etc. on the main intake, and how about economizers? Where there is a separate ventilating contract, who furnishes the tempering heaters and who connects the piping to them?

### Time

The time should be specified. Usually in new building construction it suffices that the heating and

FIG. 2—TYPICAL OIL TANK SETTING


Filler pipes and vents as direct as possible and as close to the tanks as practicable
Vent
Manhole access pit carried up to surface
Vent
U-bolts to anchor the tanks against flotation
Plug
Drain to sewer
Plug
Concrete anchor and foundation
Fill in with crushed stone for at least 2'-0" above the drain under the tanks

ventilating contractor shall carry on as rapidly as the rate of building construction allows. Adequate control and authority covering time limits for installation of the various parts of the works should be vested in the engineer.

### Cleaning

Ducts and air ways must be cleaned of debris; and piping, traps and boilers must be free from cutting grease, core sand, etc.

### Protection

The contractor must leave no open ends to gather debris, and must safeguard his own and the owner's interests in the material which is being put in the building.

### Substitutions

The contractor usually is allowed some competitive choice between equally good makes of apparatus. Since the word "equal" is often difficult to interpret, some engineers require bids on basic specific apparatus, with alternate prices on any other makes which the contractor may fancy.

### Guarantee

The contractor should make good his own workmanship and should transmit the guarantees on material through to the owner from the various manufacturers.

It is not usual for the engineer to require specific performances by the contractor as to the plant heating the building in certain weather.

### Instructions and Adjustments

The contractor should make these so that the various appliances shall function properly together and so that the plant may operate satisfactorily.

### Shop Drawings

Shop drawings of all principal items, such as boilers, fans, pumps, etc., should always be furnished, and approved by, the engineer. Such submission of shop drawings takes but a little time, and prevents many a costly mistake.

### Temporary Connections

Temporary connections usually are required. The owner often pays for them an agreed unit price upon written order of the engineer. Often temporary valves and traps and extensions to keep radiators away from walls, so as to permit plastering, are required. The dirt and the abuse during construction is not especially desirable treatment for the permanent radiator valves.

### Heating During Construction

Operation while the plant is partly finished is always a difficult procedure. The specification should clear this very definitely. Sometimes the contractor operates the plant at a per diem rate. Sometimes the general contractor operates it. Sometimes the owner operates it with his own fireman. The jurisdictional rules of labor unions often complicate this question. The owner may furnish the fuel with perfect fairness, since the winter-procedure of construction is presumably entirely for his benefit.

### Drying Out

Where there is any masonry, such as fire brick in connection with the boilers, a very slow drying-out period is desirable, with a low-intensity wood fire. Rapid heating of damp brick boiler walls will result in cracks, heaving, and shortened life of the furnace.

### Description of the Plant

At an early point in every specification, the type of plant and the type of building in which it is to go should be described. It may save the prospective bidder, for instance, much scanning of obscure clauses in the specifications if he may find the salient points summarized under this heading. Many plants are designed to serve future additions—many plants are additions in themselves. Sometimes buildings or rooms are to have temperatures higher or lower than normal.

Often, due to agreement with other parties to the contract, the building is to be specially insulated or provided with construction which affects the heating design. Sometimes certain rooms are to be left unfinished for a time, necessitating temporary installation of extra heating capacity in adjacent rooms. As a matter of self-protection, the engineer should incorporate a description of these matters most painstakingly into the specifications.

### General Construction Work

It is desirable usually in new buildings that the contractor for the heating and ventilating equipment shall supply and erect the foundations for the apparatus which he furnishes. It may be that he should connect all electrical equipment in his contract with services brought by others to some designated point. It may be that parts of the water supply piping should be in this contract. How about cutting and patching? All of these interlocking connections with the other contractors on the building should be defined very clearly.

### Boilers

The make and the size, the working pressure and the capacity should all be made clear. If the boiler does not have its own built-in insulation, proper covering should be furnished. The kind of fuel and the provisions for cleaning, firing, etc., should be described. Perhaps there is an auxiliary hot water heating boiler which may burn gas or oil.

**Grates, Stokers, Oil Burners, Gas Burners, Etc.**

These should be described fully, giving size and capacity and requiring any special guarantee that may be desirable. With stokers of mechanical type there should be some method of automatic control; also the necessary instruments for indicating fire conditions, such as draft gages, carbon dioxide indicator, coal meters, etc.

With oil burners there should be storage tanks underground, with indicators to show the amount of oil and with all necessary filling, venting, heating and circulating piping and valves. The safety controls, the cutting and patching, draining and adjusting all must be cleared up in the specifications.

The oil tanks should always have manholes so that sediment can be removed. Two alternative oil tanks probably are worth their cost over that of a single tank, since if one should become sediment-clogged, the other can maintain service. The safety-protective devices should be described minutely.

With gas burners the piping, separate meters and protective devices must be developed. Where oil or gas burners are used, the boilers should have automatic water feeders.

### Boiler Trimmings

These should be specified, with precautions to observe all ordinances and code requirements. There should always be two valves on each blow-off from a steam boiler, since one valve might be prevented from closing by scale, when blowing down under pressure, resulting in a possible explosion unless there is a second valve for emergency closing.

### Hot Water Heater

The tank for storage and the provision for heating water, as to size, capacity, material and type should be specified. The tank must have adequate supports. The heating element must be easily removable for cleaning in case of a steam-heated tank. The thermostat and the thermometer must be described and located; also the drainage and the water connections must be defined. All water heaters should have automatic pressure relief valves, since many fatal explosions of such heaters have occurred. Even though we may place no valves in the water connections to these heaters, someone else later on may create a stoppage.

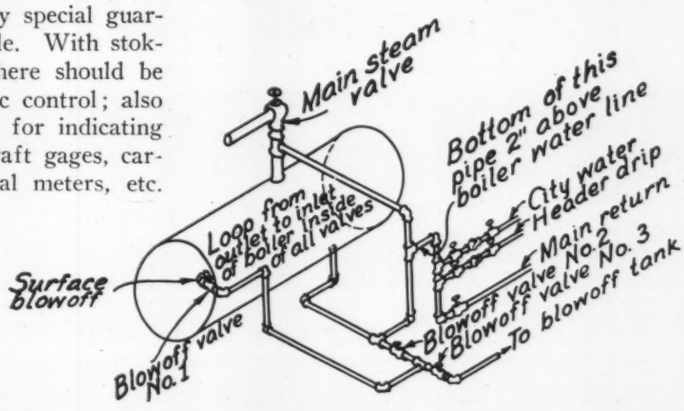

Main steam valve
Bottom of this pipe 2" above boiler water line
City water
Header drip
Main return
Blowoff valve No. 2
Blowoff valve No. 3
To blowoff tank
Loop from outlet to inlet of boiler inside of all valves
Surface blowoff
Blowoff valve No. 1

FIG. 3—HARTFORD LOOP AND SURFACE BLOW-OFF IN CONNECTION WITH BOTTOM BLOW-OFF FOR A HEATING BOILER

### Breeching

The breeching should be pointed up tight to the chimney from the inside as well as from the outside. It must have proper dampers, cleanouts, and provisions for supporting the insulation. It should be supported independently of any other apparatus, since any failure here might result in a disastrous fire. It is the practice usually to insulate the outside of a boiler breeching, though good results are possible from an interior lining made of vitrified material.

Gas boiler breechings usually are in the form of open hoods, since no chimney draft directly is desired, and since the best results are obtained from merely a neutral removal of the warm, damp products of combustion. Chimneys and breeching from gas heaters usually are subject to rapid deterioration due to the hydrogen constantly condensing out of the exhaust gases.

### Pipe and Fittings

The make, the material and the workmanship, particularly the reaming of cut ends out to full diameter, should be covered in the specifications.

No piping should be buried in the ground without adequate protective coatings and insulation and drainage.

Welding of piping by gas or by electricity is becoming so standardized that many specifications permit it alternatively; and many require welding throughout, especially on underground transmission lines. Fittings especially adapted to welding are available.

### Supports

The kind of supports and their frequency for pipes, risers, heaters, etc., should be specified in detail.

### Sleeves, Plates, Etc.

Sleeves and plates are required where pipes pass building walls, floors, etc. They may fit closely or may go outside of the pipe insulation so that no walls support any pipes. They often are built into place in new buildings long before the pipes themselves can be erected. An adjustable sleeve of great strength easily anchored to the forms is desirable in concrete structures.

### Valves

Valves should be identified on the drawings by symbols showing the different types. Sometimes, where but one valve serves some important function, a globe or an angle valve is insisted upon, while gate valves may be used in subordinate positions. Often, all valves 2½ inch and larger are flanged. Who

is to furnish the companion flanges for valves and special equipment not ordinarily provided with companion flanges by the manufacturer?

Often it is desirable to specify chain wheels on important overhead valves so that they can be manipulated by the operator from the floor.

Valves on steam radiators below the supply mains should be placed above the mains or if they must go at the radiators, there should be drain traps provided on each run-out so that whenever the radiator valve is closed, perfect drainage of the drop riser leading to the radiator valve will be insured.

Radiator valves in general should be at the top connection of the radiator where they are most easy to reach.

### Air Valves

Air valves should be the best that can be obtained. In many cases it is wise to specify anti-theft devices for these valves.

### Vacuum Traps

Vacuum traps should be specified on virtue rather than on price. It is wise on new work to operate the plant for some time with the trap-interiors removed so that cutting compounds, scale, dirt, etc., may work their way out. On all new plants, the traps should be cleaned several times during the first season's use.

The quality in a vacuum trap which makes it a successful device may also make it temperamental about foreign matter in its vitals.

Where there is heavy load, several ordinary vacuum traps may be placed as a team, in a vertical series, so that when the lowest trap is fully occupied with water the next one begins to operate; while the highest trap of the series takes care of the air.

### High Pressure Traps

High pressure traps usually should have a globe valve at the inlet, a gate valve at the outlet and an angle valve on a by-pass pipe. Supports and adequate access to these traps should be specially looked after. Often they must have automatic or manual air valves.

### Pressure Regulators and Similar Special Devices

These should have globe valves at their inlets, gate valves at their outlets and globe or angle valves on their by-passes. They should not be too large for fear of valve-seat wear when loaded lightly.

A pressure regulator on a vapor heating plant of even moderate size is helpful, since it permits of boiler pressure fluctuations without the attendant flashing-hot and flashing-cold of the heating surfaces. It may be quite desirable to operate the boiler at from two to ten pounds pressure, while never allowing the heating system pressure to rise above a few ounces pressure, and it is very much easier to do so than to hold a good sized coal or oil-fired boiler within an ounce-pressure range.

### Oil Separators and Oil Filters

Oil separators and oil filters are important where exhaust steam is used. The oil separator should have a trap which positively will not regurgitate oil back into the system if an extra high vacuum occurs, but which will extract the oil even against a vacuum.

Oil filters with renewable catridges are desirable auxiliaries in many cases, and should be placed between the boiler feed pumps and the boiler in the feed lines.

### Suction Strainer

Every vacuum pump should have a suction strainer, and the basket should be easily removable for cleaning.

### Pumps

Heating systems usually are limited to combination boiler feed and vacuum pumps. The size and make and capacity and the power and speed of the motive equipment should be specified. Usually the

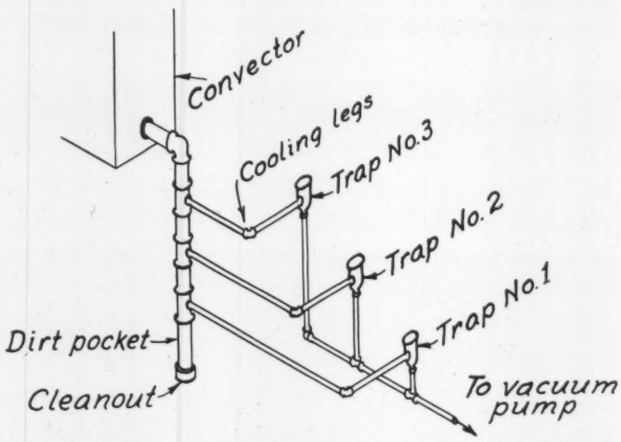



Fig. 4—Arrangement of Vacuum Traps for Heavy Duty. Trap No. 1 Normally Handles Water While No. 2 Normally Handles Air and No. 3 Is Closed. As the Work Increases All Three May Handle Water, While No. 3 Also Handles the Air

air discharge should be piped to a chimney or some noise-deadening chamber.

It is often desirable with combination boiler feed and vacuum pumps to have a manual switch whereby the vacuum governor may be by-passed, permitting the pump automatically to function as a simple boiler feed device.

### Workmanship

In every specification there should be a clause covering kind of workmanship, describing the necessity for exact leveling and grading, covering the necessity for pipe run-outs being flexible, for risers being anchored, for pipe coils being mitered, for branches to radiators being increased in size and well supported, etc.

Frequent gate valves at strategic points in the mains of large installations are a god-send when it comes to maintaining service while building the original system or to making repairs in future years.

### Gages

Gages must always be provided and piped up, with compensation for any water-head, with signs and with proper illumination. It is desirable to provide a central gage board.

*Editorial Note*: A second article on specifications by Mr. Lewis is to appear in an early issue. This second paper will cover many additional points.

# Installation and Care of Air Piping

*By* A. W. Loomis

INSTALLATION and care of compressed air piping should be governed by rules of common sense, but queerly enough many of us seem to forget common sense in laying out and installing compressed air systems.

Compressed air is comparatively expensive, and inefficient pipe lines waste money, much more than equally inefficient steam or water lines. The accompanying table (A) shows the cost of leaks in a compressed air line. In the same plant in which water and steam leaks are religiously stopped, there often will be found many compressed air leaks. At a cost of 15½ cents per 1,000 gals. of water, 60 cents per 1,000 lb. of steam, and 10 cents per 1,000 cu. ft. of air, the cost of air leakage is 3.7 times the cost of steam leakage through a similar-sized opening and 9.3 times the cost of water leakage through the same opening. Of course, many plants compress air for much less than 10 cents per 1,000 cu. ft.

The superintendent who stops all water leaks and upbraids his wife for the high water bill caused by a leaky washer in the bathroom, more often than not gives no attention to air leaks in his plant and invariably these are more numerous than either steam or water leaks, as they do not make their presence known so positively.

Thus it may be seen that large savings may be made by giving a little attention to the often-neglected air transmission system. Every plant engineer and superintendent readily can detect the major faults in a piping system and, if he will only stop to realize the savings that can be made, he more readily will co-operate in improving conditions.

### Intake Piping

The air piping system begins at the compressor intake, which is commonly located in the engine room. This practice from the standpoint of economy is inadvisable, as the average temperature of the outside air is considerably below that in buildings, and locating the intake outside results in increased compressor capacity and efficiency.

TABLE A—COST OF AIR LEAKS

| Size of Opening | AIR | |
|---|---|---|
| | No. of cu. ft. wasted per month 100 lbs. pressure | Total Cost of waste per month at 10c per 1000 cu. ft. |
| ⅛" | 9,979,200 | $997.92 |
| ¼" | 4,449,600 | 444.96 |
| ⅜" | 1,114,560 | 111.46 |
| 1/16" | 278,640 | 27.86 |
| 1/32" | 69,552 | 6.96 |

For instance, assume the average indoor temperature to be 60 deg. fahr. The air taken from the room at this temperature is heated during compression, but during its travel to the point of use it has cooled back to room temperature, and if 1,000 cu. ft. of air is taken into the compressor in a given time, 1,000 cu. ft. will be delivered at the point of use.

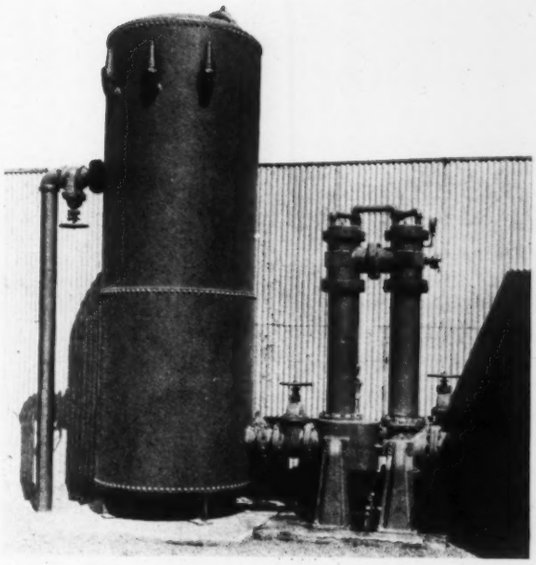


FIG. 1—AIR RECEIVER AND AFTERCOOLER SERVING A 2600 C.F.M. COMPRESSOR

Suppose now we move the intake outside where the temperature averages 45 deg. fahr. Only 971 cu. ft. will be required to deliver 1,000 cu. ft. at room temperature, or a gain of 3 per cent in efficiency.

If the compressor is supplied from an engine room where the temperature is 90 deg. fahr., 1056 cu. ft. will be required to deliver 1,000 cu. ft. at 60 deg. fahr. temperature. The gain as shown by the table (B) amounts to about one per cent for every 5 degree drop in temperature.

The expense of installing the intake pipe is practically the only extra cost involved in realizing these savings.

Air intakes should have an area at least 50 per cent greater than the area of the intake conduit, and the conduit should never be smaller than the intake opening on the compressor. A long conduit should have its diameter increased. A good rule in this case is to increase the diameter 1 in. for every ten feet of length. In all cases the intake should be as short and direct as possible.

### Pulsations in the Conduit

In rare cases an intake conduit may be of such length and diameter that the pulsations of air in the conduit, set up by the variation in speed of the piston, will tend to supercharge the compressor. In one case of this

TABLE B—EFFECT OF INTAKE TEMPERATURE ON EFFICIENCY AND CAPACITY OF AIR COMPRESSORS

Unit Capacity and Efficiency Assumed at 60°F.

| Initial Temperature | | Relative Capacities and Efficiencies | Initial Temperature | | Relative Capacities and Efficiencies |
|---|---|---|---|---|---|
| Degrees Fahr. | Degrees Absolute | | Degrees Fahr. | Degrees Absolute | |
| —20 | 440 | 1.182 | 70 | 530 | 0.981 |
| —10 | 450 | 1.155 | 80 | 540 | 0.963 |
| 0 | 460 | 1.130 | 90 | 550 | 0.945 |
| 10 | 470 | 1.105 | 100 | 560 | 0.928 |
| 20 | 480 | 1.083 | 110 | 570 | 0.912 |
| 30 | 490 | 1.060 | 120 | 580 | 0.897 |
| 32 | 492 | 1.058 | 130 | 590 | 0.882 |
| 40 | 500 | 1.040 | 140 | 600 | 0.867 |
| 50 | 510 | 1.020 | 150 | 610 | 0.853 |
| 60 | 520 | 1.000 | 160 | 620 | 0.839 |

kind the owner of the compressors complained that his motors were heating from overloading. Engineers from the manufacturer's plant investigated and told the owner the cause of his trouble. He refused to believe such a condition was possible, so the intake was shortened with the compressor running and the owner watched the ammeter. An immediate drop in ammeter reading was noticed when the intake was shortened. The remedy for such a condition is to shorten or lengthen the intake conduit, or possibly increase the diameter.

FIG. 2—AIR RECEIVERS PROPERLY INSTALLED OUTDOORS, AND AIR FILTERS INSTALLED ON THE COMPRESSOR INTAKES. NOTE THAT FILTERS ARE PROTECTED SO THAT RAIN CAN NOT BE BLOWN DIRECTLY INTO THEM

The conduit itself may be made of standard steel pipe, sheet metal pipe, brick, vitrified sewer pipe, or concrete. If the intake is above ground, standard steel pipe or sheet metal pipe makes a very substantial conduit. Wood is sometimes used, but should always be lined with sheet metal, as it will invariably develop cracks through which dust and dirt will be drawn if it is unlined.

Vitrified sewer pipe is an excellent material for underground conduits, as it is convenient and long sweeping elbows of like material are available. All joints must be cemented to make them watertight, as any water seeping into the intake is carried into the low pressure air cylinder, washing out lubrication and causing excess wear.

If a concrete duct is used, care must be taken to see that the interior surface is smooth and hard as any particles crumbling from the sides due to the rush of air through the conduit will be drawn into the compressor. It is often economical where concrete is used to line the ducts with vitrified sewer pipe, which acts as a form for the concrete and need not be removed afterwards, as it serves as a much better lining than any finish that could be put on the concrete. In all cases, sharp bends should be avoided.

The intake duct is carried outside to the coldest possible air and the opening should be hooded to prevent the entrance of rain and screened to keep out dust and large particles of foreign matter.

Air filters are not mandatory, but they are desirable, especially where there is dust and dirt, and are adaptable to all makes and sizes of compressors. There are many types and the manufacturers will recommend the proper size for a given compressor. Around quarries or places where there is a great deal of dust, an air filter is always well worth the cost of installation.

### Aftercoolers

The discharge pipe to the receiver and aftercooler should be as short and direct as possible and as large or even larger than the discharge opening on the compressor. If an aftercooler is used, it should be installed indoors between the compressor and the receiver.

In recent years aftercoolers have come into wide use because of the economies they effect in operation of tools and maintenance of pipe lines. The purpose of the aftercooler is to remove water and oil from the air.

Instances have been noted where the amount of water reaching the tools was so great that the operator of a pneumatic hoist was subjected to a shower bath whenever he started the hoist after a short period of idleness. Almost everyone has noticed the amount of water which is blown out of an air connection toward which the distribution system drains. Salesmen report many instances of burned and warped bearings in pneumatic drills, etc., which are directly traceable to water having washed out the lubrication. Others report scored pistons and valves from rust carried into the tools from pipes corroded by condensate.

An idea of the amount of water condensed from the air may be obtained from Table C. Saturated air at 80 deg. at compressor intake (zero lb.) contains 1.57 lb. of moisture per 1,000 cu. ft. Saturated conditions often exist, as during a rain storm or fog, and in most sections of the country there is a high moisture content at all times. Compressed to 100 lb. and cooled back to 80 deg. this air will hold only 0.20 lb. Therefore, 1.37 lb. have been condensed. This would all go into the pipe lines and tools if no aftercooler or separator were used. The condensation from a 1,000-ft. single-stage compressor will under these conditions amount to 9.8 gallons per hour. Of course, the intercooler on a two-stage compressor removes much of this water, but even in this case the aftercooler will remove 2.6 gallons per hour.

The benefits of removing the excess moisture in air have been shown in thousands of cases. Dry air assures efficient operation of pneumatic tools and reduces the cost of maintenance and replacement.

Moisture can be removed effectively by means of aftercoolers, and they will save their cost many times over in the majority of cases. They cool the air to a point where most of the moisture in the air condenses and can be removed. The aftercoolers are installed near the compressor and the air leaves them at a uniformly low

temperature, saving pipe lines and tools from the devastating effects of rust, expansion, and contraction.

### Receivers

The discharge from the compressor or from the aftercooler, if one is used, should be connected near the top of the receiver. Air receivers have in some cases exploded and injured people. In nearly every case of this character investigation has shown that the receiver consisted of some old boiler or tank unsuitable for the service, or that no care had been used to see that the receiver was kept in proper operating conditions. A few simple rules for safe installations follow:

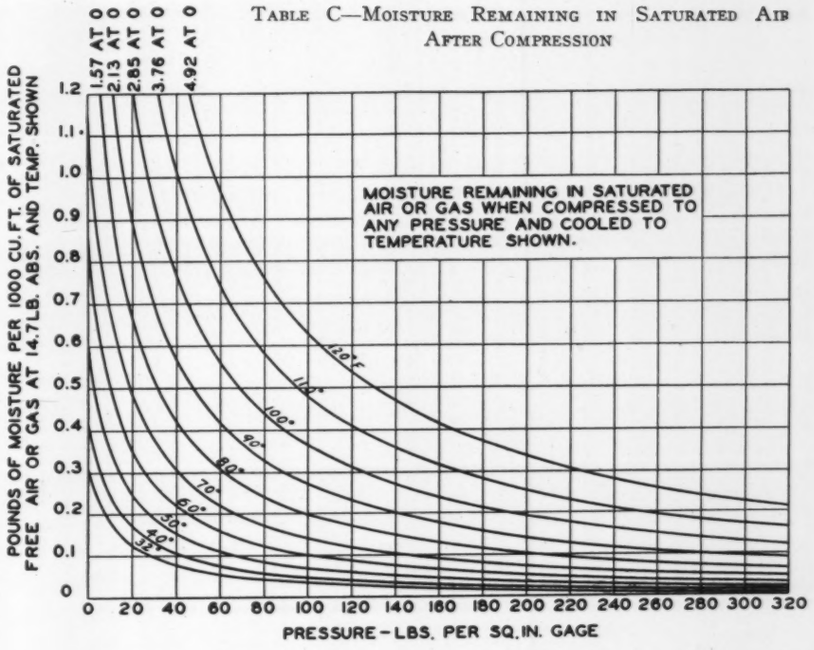
1. Connect compressor to receiver as directly as possible, using full size pipe all the way.
2. Avoid sharp turns and bends.
3. Never (except as explained below) place a valve between the compressor and the receiver or aftercooler.
4. Wherever possible, place receiver outside of building.
5. Be sure each receiver is equipped with a safety valve in working order and set at the proper pressure.
6. Use only receivers tested and approved by competent authorities (receivers built to A. S. M. E. standards are carefully tested by the manufacturers. California and Massachusetts have special standards for which manufacturers furnish special receivers.)
7. See that receiver has a proper drain at the bottom.
8. Inspect and clean regularly.

For unusual conditions it may be necessary to place a valve in the pipe line to the receiver. This may be done if a tee is inserted ahead of the valve and a short length of pipe with a safety valve and globe valve upon it is screwed into this tee. This device will prevent the pressure being suddenly built up in case the shut-off valve is closed, and will also give warning, enabling the unit to be shut down before any damage occurs.

Regular draining of the receiver and periodical cleaning are extremely important. It is good practice for the engineer to open the drain cock on the receiver every day before, or just after, starting the compressor.

Periodical cleaning is also important, especially where no aftercooler is used, as a deposit of carbonized oil tends to collect on the sides of the receiver and dangerous pressures are developed almost instantly if this becomes ignited.

Table C—Moisture Remaining in Saturated Air After Compression


1.57 AT 0
2.13 AT 0
2.85 AT 0
3.76 AT 0
4.92 AT 0
MOISTURE REMAINING IN SATURATED AIR OR GAS WHEN COMPRESSED TO ANY PRESSURE AND COOLED TO TEMPERATURE SHOWN.
POUNDS OF MOISTURE PER 1000 CU. FT. OF SATURATED FREE AIR OR GAS AT 14.7 LB. ABS. AND TEMP. SHOWN
120°F
110°
100°
90°
80°
70°
60°
50°
40°
32°
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320
PRESSURE - LBS. PER SQ. IN. GAGE

### Cleaning Receiver and Discharge Pipe

An excellent solution for cleaning the receiver and the discharge pipe between the compressor and the receiver consists of 1 lb. of best grade lye dissolved in 2 gallons of water. If this mixture is forced into the discharge pipe at the rate of about 70 drops a minute, while the compressor is running, all the accumulation of oil and carbon will be removed from the pipe and receiver walls and can be removed from the receiver by opening the blow-off valve. Care should be taken to introduce the mixture at a point where it will not run back into the compressor. The mixture can be introduced by placing it in an air tight container (one made from 6-in. pipe with caps on both ends will do) which is tapped into the discharge pipe. It will be necessary to connect the top of this container to the receiver or to another point in the discharge line in order to balance the pressures. A small pet cock may be used in order to regulate the flow of the mixture from the container to the pipe.

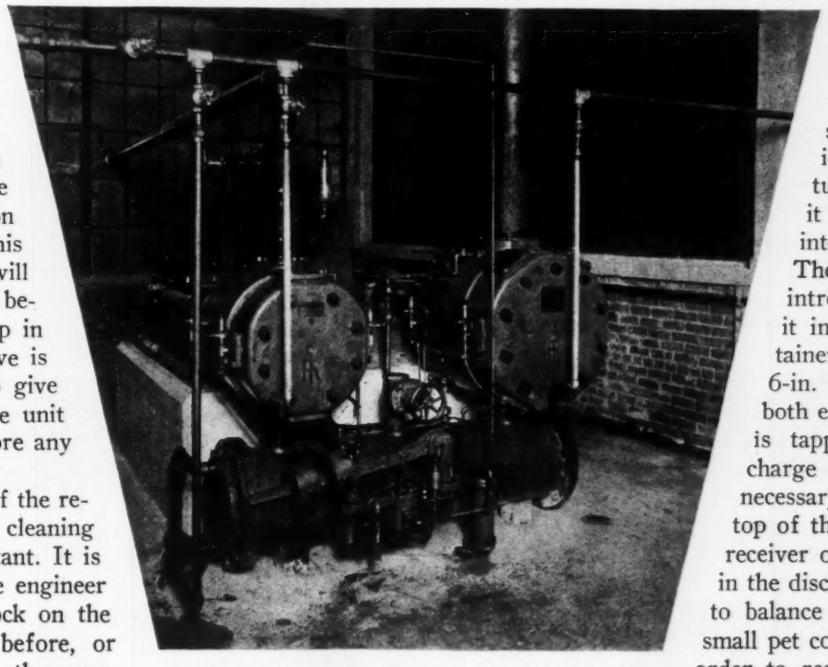


Fig. 3—Safety Valve Properly Installed Ahead of a Valve in the Discharge Line to the Receiver

## Discharge Piping

In laying out the piping system the same rules apply as for other systems. Ample allowance should be made for future growth. A large pipe line is to be preferred to one that is small, as extra size does no harm, while undersized transmission lines mean wasted power because of excessive loss of pressure due to friction. Large lines are extremely important where they are very long or the demand for air is from a large variety of tools. Sharp bends and elbows should be avoided, as they mean restriction and friction. The accompanying Tables D show the friction losses in ordinary transmission and will prove extremely valuable in laying out air piping.

All joints should be set up with red lead for tightness and it is important that they should be kept tight continually for leaks are costly. A lighted candle or taper used on air lines will quickly indicate any leaks.

Low spots in the pipe should be avoided, and the pipe should be installed so that it will drain to traps suitably located for the removal of moisture. Taps from the main line should be made with a tee pointing upward. In this way whatever moisture may be in the main line will not drain into the tap.

A sufficient number of outlets should be provided for future requirements. This precaution will save remodelling and will prevent use of excessively long hose. Hose sizes should be standardized so that all will interchange. A shut-off valve should be supplied for every outlet; otherwise workers will be inconvenienced and air wasted.

## Expansion Joints

It is well to remember that it may be necessary at times to dismantle parts of the air line. Flange joints placed at intervals in the pipe line will lighten the dismantling job. Unless sections of straight pipe are so fastened that longitudinal movement is prevented, expansion will take care of itself, as the temperature changes in a shop are not great and there are numerous bends in the line which will permit slight movements of the pipe. However, on out-door lines the problem of expansion is very important. Suitable expansion joints should be supplied.

Out-door pipe lines should never be allowed to rest on the ground. In some installations the lines have been placed on rollers above the ground. A better method, where permanency warrants the extra expense, is to run the lines in concrete conduits accessible for occasional inspection. Often conduits for steam lines, power lines, etc., are available and may be used.

## Piping for High Air Pressures

In some plants very high pressures are used for special process work. It should be remembered, in laying out pipe lines for high pressure work, that the extra thickness of pipe is secured by reduction of the internal diameter; the outside diameters and the threading of the fittings do not change. On this account it may be necessary to use pipe one or more sizes above that which would otherwise be employed.

The elimination of sharp bends is extremely important in high pressure piping, as the high pressures tend to straighten the piping and the friction loss through bends is very great. All high pressure piping should be fastened securely to the wall, as high pressures are dangerous if they begin to tear things loose.

## Pipe Lines Should Be Identified by Color

Many plants have several pipe systems, such as gas,

TABLE D—FRICTION OF AIR IN PIPES

| Delivery in Cu. Ft. of Compressed Air per Min. | Equiv. Delivery in Cu. Ft. of Free Air per Min. | Size of Pipe, Inches: 1 | 1¼ | 1½ | 2 | 2½ | 3 | 3½ | 4 | 4½ | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Loss of Pressure, in Pounds, by Friction in 1000 Feet Lengths of Pipe | | | | | | | | | | | | | | | | | | | |
| **At 100 Pounds Gauge** | | | | | | | | | | | | | | | | | | | |
| 6.41 | 50 | 11.89 | 3.29 | 1.28 | .27 | .08 | .03 | .01 | | | | | | | | | | | |
| 9.61 | 75 | | 7.42 | 2.87 | .62 | .19 | .08 | .03 | .01 | | | | | | | | | | |
| 12.81 | 100 | | 13.20 | 5.11 | 1.15 | .34 | .12 | .05 | .02 | .01 | | | | | | | | | |
| 15.81 | 125 | | | 7.75 | 1.68 | .52 | .19 | .08 | .04 | .02 | .01 | | | | | | | | |
| 19.22 | 150 | | | 11.42 | 2.48 | .76 | .29 | .13 | .06 | .03 | .02 | .01 | | | | | | | |
| 22.39 | 175 | | | | 3.36 | 1.03 | .39 | .17 | .09 | .04 | .03 | .01 | | | | | | | |
| 25.62 | 200 | | | | 4.43 | 1.36 | .51 | .23 | .12 | .06 | .04 | .02 | .01 | | | | | | |
| 31.62 | 250 | | | | 6.72 | 2.06 | .77 | .35 | .17 | .09 | .05 | .02 | .01 | | | | | | |
| 38.44 | 300 | | | | 9.95 | 3.04 | 1.14 | .51 | .25 | .14 | .08 | .03 | .01 | | | | | | |
| 44.78 | 350 | | | | 13.41 | 4.11 | 1.54 | .69 | .34 | .19 | .11 | .04 | .02 | .01 | | | | | |
| 51.24 | 400 | | | | | 5.40 | 2.06 | .92 | .45 | .25 | .15 | .05 | .03 | .01 | | | | | |
| 57.65 | 450 | | | | | 6.85 | 2.57 | 1.16 | .57 | .32 | .18 | .07 | .03 | .02 | .01 | | | | |
| 63.24 | 500 | | | | | 8.21 | 3.08 | 1.39 | .68 | .38 | .22 | .08 | .04 | .02 | .01 | | | | |
| 76.88 | 600 | | | | | 12.21 | 4.58 | 2.14 | 1.03 | .57 | .33 | .12 | .05 | .03 | .02 | .01 | | | |
| 89.56 | 700 | | | | | | 6.19 | 2.79 | 1.38 | .77 | .44 | .17 | .07 | .04 | .02 | .01 | | | |
| 102.5 | 800 | | | | | | 8.13 | 3.67 | 1.81 | 1.00 | .57 | .22 | .10 | .05 | .03 | .02 | .01 | | |
| 115.3 | 900 | | | | | | 10.23 | 4.64 | 2.29 | 1.27 | .76 | .28 | .13 | .06 | .04 | .02 | .01 | | |
| 126.5 | 1000 | | | | | | 12.39 | 5.00 | 2.76 | 1.23 | .88 | .34 | .16 | .08 | .04 | .03 | .01 | | |
| 192.2 | 1500 | | | | | | | 12.81 | 6.68 | 3.51 | 2.03 | .78 | .36 | .18 | .09 | .05 | .02 | .01 | |
| 256.2 | 2000 | | | | | | | | 11.35 | 6.61 | 3.62 | 1.41 | .67 | .33 | .18 | .10 | .04 | .02 | .01 |
| 316.2 | 2500 | | | | | | | | | 9.50 | 5.51 | 2.14 | .97 | .49 | .27 | .16 | .06 | .03 | .01 |
| 384.4 | 3000 | | | | | | | | | 14.04 | 8.11 | 3.16 | 1.44 | .76 | .39 | .23 | .09 | .04 | .02 |
| 447.8 | 3500 | | | | | | | | | | 10.95 | 4.26 | 1.93 | .98 | .53 | .31 | .12 | .05 | .03 |
| 512.4 | 4000 | | | | | | | | | | 14.48 | 5.59 | 2.55 | 1.30 | .72 | .41 | .16 | .07 | .04 |
| 576.5 | 4500 | | | | | | | | | | | 7.04 | 3.22 | 1.84 | .89 | .52 | .21 | .09 | .05 |
| 632.4 | 5000 | | | | | | | | | | | 8.51 | 3.88 | 1.93 | 1.07 | .63 | .25 | .11 | .08 |
| **At 125 Pounds Gauge** | | | | | | | | | | | | | | | | | | | |
| 5.26 | 50 | 9.88 | 2.70 | 1.05 | .23 | .07 | .03 | .01 | | | | | | | | | | | |
| 7.89 | 75 | | 22.20 | 6.07 | 2.37 | .51 | .16 | .06 | .03 | .01 | | | | | | | | | |
| 10.51 | 100 | 39.50 | 10.82 | 4.22 | .91 | .28 | .10 | .05 | .02 | .01 | | | | | | | | | |
| 13.15 | 125 | | 16.88 | 6.58 | 1.42 | .43 | .16 | .07 | .04 | .02 | .01 | | | | | | | | |
| 15.79 | 150 | | 24.33 | 9.47 | 2.04 | .63 | .23 | .11 | .05 | .03 | .02 | .01 | | | | | | | |
| 18.41 | 175 | | 33.05 | 12.90 | 2.78 | .85 | .32 | .14 | .07 | .04 | .02 | .01 | | | | | | | |
| 21.05 | 200 | | | 16.84 | 3.63 | 1.11 | .42 | .19 | .09 | .05 | .03 | .01 | | | | | | | |
| 26.30 | 250 | | | 26.30 | 5.58 | 1.73 | .65 | .29 | .15 | .08 | .05 | .02 | .01 | | | | | | |
| 31.58 | 300 | | | 37.90 | 8.18 | 2.51 | .94 | .42 | .21 | .12 | .07 | .03 | .01 | | | | | | |
| 36.81 | 350 | | | | 11.08 | 3.39 | 1.27 | .58 | .28 | .16 | .09 | .04 | .02 | .01 | | | | | |
| 42.10 | 400 | | | | 14.51 | 4.44 | 1.67 | .75 | .37 | .21 | .12 | .05 | .02 | .01 | | | | | |
| 47.30 | 450 | | | | 18.38 | 5.61 | 2.11 | .95 | .47 | .26 | .15 | .06 | .03 | .01 | .01 | | | | |
| 52.60 | 500 | | | | 22.68 | 6.95 | 2.61 | 1.18 | .58 | .32 | .18 | .07 | .03 | .02 | .01 | | | | |
| 63.20 | 600 | | | | | 10.00 | 3.76 | 1.69 | .84 | .46 | .27 | .10 | .05 | .02 | .01 | .01 | | | |
| 73.70 | 700 | | | | | 13.60 | 5.11 | 2.31 | 1.14 | .63 | .36 | .14 | .06 | .03 | .02 | .01 | | | |
| 84.20 | 800 | | | | | 17.80 | 6.68 | 3.01 | 1.49 | .83 | .47 | .18 | .08 | .04 | .02 | .01 | .01 | | |
| 94.70 | 900 | | | | | | 8.45 | 3.81 | 1.88 | 1.04 | .60 | .23 | .11 | .05 | .03 | .02 | .01 | | |
| 105.1 | 1000 | | | | | | 10.42 | 4.71 | 2.32 | 1.29 | .74 | .29 | .13 | .07 | .04 | .02 | .01 | | |
| 157.9 | 1500 | | | | | | 23.48 | 10.59 | 5.23 | 2.90 | 1.65 | .64 | .29 | .15 | .08 | .05 | .02 | .01 | |
| 210.5 | 2000 | | | | | | | 18.81 | 9.30 | 5.15 | 2.94 | 1.15 | .52 | .26 | .15 | .08 | .03 | .02 | .01 |
| 263.0 | 2500 | | | | | | | 29.40 | 14.52 | 8.05 | 4.60 | 1.80 | .82 | .41 | .23 | .13 | .05 | .02 | .01 |
| 315.8 | 3000 | | | | | | | | 20.90 | 11.59 | 6.63 | 2.59 | 1.18 | .60 | .33 | .19 | .07 | .03 | .02 |
| 368.1 | 3500 | | | | | | | | 28.51 | 15.78 | 9.01 | 3.53 | 1.61 | .81 | .45 | .26 | .10 | .04 | .02 |
| 422.0 | 4000 | | | | | | | | | 20.61 | 11.80 | 4.61 | 2.19 | 1.06 | .58 | .34 | .13 | .06 | .03 |
| 473.0 | 4500 | | | | | | | | | 26.10 | 14.90 | 5.83 | 2.65 | 1.34 | .73 | .43 | .17 | .08 | .04 |
| 526.0 | 5000 | | | | | | | | | 32.20 | 18.45 | 7.20 | 3.27 | 1.65 | .90 | .53 | .21 | .10 | .05 |

For longer or shorter pipes the friction loss is proportional to the length, *i.e.*, for 500 feet ½ of the above; for 4,000 feet four times the above, etc.

| Delivery in Cu. Ft. of Compressed Air per Min. | Equiv. Delivery in Cu. Ft. of Free Air per Min. | Size of Pipe, Inches: 1 | 1¼ | 1½ | 2 | 2½ | 3 | 3½ | 4 | 4½ | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Loss of Pressure, in Pounds, by Friction in 1000 Feet Lengths of Pipe | | | | | | | | | | | | | | | | | | | |
| **At 60 Pounds Gauge** | | | | | | | | | | | | | | | | | | | |
| 9.84 | 50 | 18.24 | 5.08 | 1.95 | .42 | .13 | .05 | | | | | | | | | | | | |
| 14.73 | 75 | | 11.34 | 4.33 | .95 | .29 | .11 | .05 | | | | | | | | | | | |
| 19.64 | 100 | | 20.16 | 7.79 | 1.69 | .52 | .19 | .08 | .04 | | | | | | | | | | |
| 24.60 | 125 | | | 12.23 | 2.65 | .81 | .30 | .13 | .07 | .03 | | | | | | | | | |
| 29.45 | 150 | | | 17.53 | 3.80 | 1.16 | .44 | .20 | .09 | .05 | .03 | | | | | | | | |
| 34.44 | 175 | | | | 5.17 | 1.58 | .59 | .26 | .13 | .07 | .04 | .01 | | | | | | | |
| 39.35 | 200 | | | | 6.77 | 2.09 | .78 | .36 | .17 | .09 | .06 | .02 | .01 | | | | | | |
| 49.20 | 250 | | | | 10.61 | 3.24 | 1.22 | .55 | .27 | .15 | .08 | .03 | .01 | | | | | | |
| 58.90 | 300 | | | | 15.20 | 4.65 | 1.78 | .78 | .38 | .21 | .12 | .05 | .02 | .01 | | | | | |
| 68.6 | 350 | | | | | 6.31 | 2.37 | 1.07 | .53 | .29 | .17 | .06 | .03 | .01 | | | | | |
| 78.6 | 400 | | | | | 8.28 | 3.11 | 1.40 | .69 | .39 | .22 | .08 | .04 | .01 | | | | | |
| 88.4 | 450 | | | | | 10.47 | 3.94 | 1.77 | .88 | .48 | .28 | .11 | .05 | .02 | .01 | | | | |
| 98.4 | 500 | | | | | | 4.88 | 2.20 | 1.08 | .60 | .34 | .14 | .06 | .03 | .01 | | | | |
| 118.1 | 600 | | | | | | 7.03 | 3.17 | 1.56 | .87 | .49 | .19 | .09 | .04 | .02 | .01 | | | |
| 137.5 | 700 | | | | | | 9.52 | 4.29 | 2.12 | 1.17 | .67 | .27 | .12 | .06 | .03 | .02 | | | |
| 156.6 | 800 | | | | | | | 5.57 | 2.75 | 1.52 | .87 | .34 | .15 | .08 | .04 | .03 | .01 | | |
| 176.5 | 900 | | | | | | | 7.06 | 3.49 | 1.94 | 1.17 | .43 | .19 | .09 | .05 | .03 | .01 | | |
| 196.4 | 1000 | | | | | | | 8.77 | 4.33 | 2.40 | 1.37 | .54 | .24 | .12 | .06 | .04 | .02 | .01 | |
| 294.5 | 1500 | | | | | | | | 9.73 | 5.39 | 3.08 | 1.20 | .55 | .27 | .15 | .09 | .03 | .01 | |
| 393.7 | 2000 | | | | | | | | | 9.65 | 5.51 | 2.16 | .98 | .41 | .27 | .16 | .06 | .03 | .01 |
| 492 | 2500 | | | | | | | | | | 8.61 | 3.36 | 1.53 | .77 | .42 | .25 | .09 | .04 | .02 |
| 589 | 3000 | | | | | | | | | | | 4.82 | 2.19 | 1.11 | .61 | .36 | .14 | .06 | .03 |
| 686 | 3500 | | | | | | | | | | | 6.54 | 2.97 | 1.50 | .83 | .48 | .19 | .09 | .04 |
| 786 | 4000 | | | | | | | | | | | | 3.91 | 1.98 | 1.08 | .63 | .25 | .11 | .05 |
| 884 | 4500 | | | | | | | | | | | | 4.94 | 2.51 | 1.36 | .79 | .32 | .15 | .07 |
| 984 | 5000 | | | | | | | | | | | | 6.19 | 3.10 | 1.69 | .99 | .39 | .18 | .09 |
| **At 80 Pounds Gauge** | | | | | | | | | | | | | | | | | | | |
| 7.74 | 50 | 14.31 | 3.96 | 1.53 | .33 | .10 | .03 | .01 | | | | | | | | | | | |
| 11.3 | 75 | | 8.46 | 3.20 | .71 | .21 | .08 | .03 | .01 | | | | | | | | | | |
| 15.2 | 100 | | 15.31 | 5.92 | 1.28 | .39 | .14 | .06 | .03 | .02 | .01 | | | | | | | | |
| 19.4 | 125 | | | 9.64 | 2.09 | .64 | .24 | .11 | .05 | .03 | .02 | .01 | | | | | | | |
| 23.2 | 150 | | | 13.79 | 2.99 | .91 | .34 | .15 | .07 | .04 | .02 | .01 | | | | | | | |
| 27.2 | 175 | | | | 4.09 | 1.25 | .47 | .21 | .10 | .06 | .03 | .01 | | | | | | | |
| 31.0 | 200 | | | | 5.34 | 1.63 | .61 | .27 | .13 | .07 | .04 | .01 | | | | | | | |
| 38.7 | 250 | | | | 8.32 | 2.54 | .96 | .43 | .21 | .12 | .07 | .02 | .01 | | | | | | |
| 46.5 | 300 | | | | 12.01 | 3.67 | 1.38 | .62 | .30 | .17 | .09 | .03 | .01 | | | | | | |
| 54.2 | 350 | | | | | 4.99 | 1.88 | .84 | .41 | .23 | .13 | .05 | .02 | .01 | | | | | |
| 62.0 | 400 | | | | | 6.53 | 2.45 | 1.11 | .54 | .30 | .17 | .06 | .03 | .01 | | | | | |
| 69.7 | 450 | | | | | 8.25 | 3.13 | 1.40 | .69 | .38 | .22 | .08 | .04 | .01 | | | | | |
| 77.4 | 500 | | | | | 10.81 | 3.83 | 1.73 | .85 | .47 | .27 | .10 | .05 | .02 | .01 | | | | |
| 92.9 | 600 | | | | | | 5.61 | 2.46 | 1.22 | .68 | .39 | .15 | .06 | .03 | .02 | .01 | | | |
| 108.2 | 700 | | | | | | 7.46 | 3.37 | 1.66 | .92 | .53 | .20 | .09 | .04 | .02 | .01 | | | |
| 124.0 | 800 | | | | | | 9.86 | 4.42 | 2.18 | 1.19 | .69 | .27 | .12 | .06 | .03 | .02 | .01 | | |
| 139.5 | 900 | | | | | | | 5.61 | 2.77 | 1.54 | .88 | .34 | .15 | .08 | .04 | .02 | .01 | | |
| 152 | 1000 | | | | | | | 6.64 | 3.29 | 1.82 | 1.04 | .40 | .18 | .09 | .05 | .03 | .01 | | |
| 232 | 1500 | | | | | | | 15.41 | 7.62 | 4.24 | 2.43 | .93 | .43 | .22 | .12 | .06 | .02 | .01 | |
| 310 | 2000 | | | | | | | | 13.62 | 7.58 | 4.32 | 1.69 | .77 | .39 | .21 | .12 | .04 | .02 | .01 |
| 387 | 2500 | | | | | | | | | 11.79 | 6.88 | 2.64 | 1.19 | .60 | .33 | .19 | .07 | .03 | .01 |
| 465 | 3000 | | | | | | | | | | 9.72 | 3.79 | 1.73 | .87 | .48 | .28 | .11 | .05 | .02 |
| 542 | 3500 | | | | | | | | | | 13.25 | 5.27 | 2.35 | 1.19 | .65 | .37 | .15 | .06 | .03 |
| 620 | 4000 | | | | | | | | | | | 6.78 | 3.07 | 1.55 | .85 | .49 | .19 | .09 | .04 |
| 697 | 4500 | | | | | | | | | | | 8.54 | 3.89 | 1.97 | 1.08 | .66 | .25 | .11 | .05 |
| 774 | 5000 | | | | | | | | | | | 10.55 | 4.79 | 2.46 | 1.33 | .77 | .30 | .14 | .07 |

For longer or shorter pipes the friction loss is proportional to the length, *i.e.*, for 500 feet ½ of the above; for 4,000 feet four times the above, etc.

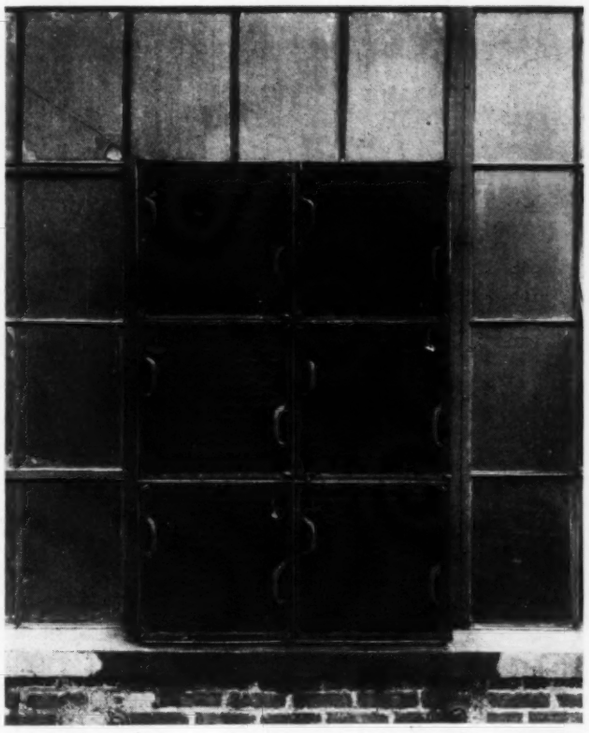


FIG. 4—AIR FILTER INSTALLED OUTDOORS TO OBTAIN COOL INTAKE AIR

water, compressed air, etc., all of which serve the same points. It is well to paint the pipes of each system with a distinguishing color and post keys to the color system in prominent places around the plant. This will aid in making repairs and prevent many minor delays and mistakes. If both low and high pressure air is used, the systems should be positively identified by color and fittings should be such that it is absolutely impossible to connect low pressure air tools to the high pressure system.

Many manufacturers feel that the 5, 10, or 15 per cent of power that would be saved by proper placement and care of transmission lines is such a small portion of their total power cost that the expense of proper maintenance is not warranted. The actual saving may be a small portion of total operating expense, but every bit helps and usually losses due to leaks and inefficiency are greater than is realized.

For instance, one of the large copper mines found at one time that it took nearly 30 per cent of its operated compressor capacity to keep air in the lines on holidays when no work was being done. If, by reducing leaks and inefficiency of operation you can not only save a large percentage on operating cost but even reduce the size or number of compressors needed, that surely is worth while.

## Piping Coffee

In Venezuela, coffee is grown on high plateaus. The coffee beans are carried down to the shipping depots in the valleys through pipe lines, often five miles long. Delivery of a load of coffee beans by pipe lines takes less than an hour, by burro the trip takes half a day. There are more pipe lines, in Venezuela, transporting coffee than crude oil.

## Steam Trap Prevents Valve Trouble

All installations of steam reducing and regulating valves should be arranged to prevent as much condensation water as possible from getting into the valve. If the piping arrangement requires some horizontal or overhead piping leading to the valve for the steam supply, place a drain pocket with a reliable steam trap immediately ahead of the stop valve, controlling the steam supply to the reducing valve. A slug of water accumulating near the valve will produce water hammer when the valve opens which will be detrimental to the interior parts and result in scored or cut valve disc faces, causing the valve to leak when in the closed position.

Reducing valves should be selected according to the amount of flow required through the valve and not by the pipe sizes of the valve connections. The manufacturers of the valve will give the amount of steam or other fluids that the valve will pass and this should be the guide for the selection of the proper size, even if it is necessary to use reducing pattern fittings to install the valve in the pipe line. When it is necessary to reduce high steam pressures, frequently a 4-inch reducing valve will be of ample size to supply properly a 6-inch steam supply main. In reducing from high pressure to medium or low pressure, in many cases a valve is used that is too large. In cases of this kind better results can be obtained by using a valve one or two sizes smaller than the pipe line.

For use in controlling very low reduced pressures, say from 10-lb. initial or inlet pressure to ½ or ¼ lb. reduced or delivery pressure, and where a large volume is required necessitating the use of a large size valve, it is better to use a reducing valve a size larger than the pipe line, especially when there is a large demand at irregular intervals.

Reducing valves used for reducing from a high inlet pressure to a low delivery pressure are frequently of the expanded outlet pattern, the outlet of the valve being of a larger pipe size than the inlet.

### Reducing Pressure by Stages

When there is a marked difference in the pressure reduction, it is common practice to use two or more reducing valves and reduce by stages. For example when the inlet pressure is 200 lb. and the delivery pressure is from ½ to 5 lb., two valves are generally used, the first valve reducing to about 75 lb. and the second valve reducing from this pressure to the required low delivery pressure.

Reducing valves installed for this purpose in series or tandem should have a full size section of pipe of a suitable length between the valves to act as a receiver for the steam supply to the second valve, which will result in a steadier and better operation of the valve.

Reducing valves of some types are constructed so that the pressure on the outlet side of the valve can get directly to the diaphragm, piston or other means of operating the valve, to govern the regulation of the reducing valve and control the outlet pressure.—*W. H. W.*

# The Thermal Load Diagram

*By* Herman Vetter

WHENEVER it is possible to plot our problems in the form of a diagram, the solution is more easily found. In this article we will describe a form of diagram that may be used to advantage when designing refrigerating plants and can also be used for analyzing existing plants when added capacity is necessary or when more efficiency is demanded.

This form of diagram is called a "Thermal Load Diagram." For steady loads such as ice plants and general cold storage, this type of diagram is not essential; for plants such as dairies, ice cream and abattoir refrigeration, where the refrigeration load varies hourly, thermal load diagrams are very helpful.

It is not the purpose of this article to show how to handle various problems, but to show how problems may more easily be analyzed by the use of a diagram. In laying out the diagram, the base represents the time and should be divided into hourly periods. Smaller divisions may be used if found necessary. When laid out in hourly periods the vertical co-ordinates represent the hourly load in British thermal units. We will describe the two following illustrations so that a better idea of this form of diagram may be obtained.

Diagram No. 1 represents, graphically, the thermal load of a drinking water system for a hotel. The shaded portion represents the actual thermal load as nearly as could be calculated. As the water cooling only represents part of the refrigerating load of a hotel, this diagram should be transferred to the diagram of the balance of the load. As this would complicate our explanation, we will handle this problem independently.

The water tank used measured three feet in diameter and six feet, nine inches high. The top section of the tank was reserved for the brine coils, which were of the Baudelot type. The lower portion of the tank was used for water storage and had capacity for 160 gallons.

We are now in a position to see how the peaks in our diagram can be lowered without noticeable difference in water temperature. The water in storage, which in this case amounts to 160 gallons and with a four-degree range, has a thermal storage capacity of 5,300 B.tu. The peaks may therefore be reduced to that shown by dotted lines *B-B* and *G-G*. The area thus removed is placed in the valleys at *C-C* and *H-H*. The outline *A-A, B-B, C-C, D-D, E-E, F-F, G-G* and *H-H* now represents the thermal load.

We will assume that we have a 3-ton compressor available and see how this could be made to serve our purpose. The dash and dot line represents the compressor capacity line. The peak *B-B* is our highest peak and as the compressor line falls below it, it becomes necessary to provide sufficient brine capacity to store thermal energy equivalent to that represented in the cross-sectioned area between *B-B* and the compressor line. The volume in this area equals 39,810 B.tu, and this converted into brine storage would be found by the following formula:

$$\frac{\text{Load in B.tu}}{\text{Wgt. of brine} \times \text{Sp. ht.} \times \text{temp. rise}} = \text{cu. ft. brine}$$

$$\frac{39{,}810 \text{ B.tu}}{75 \text{ lb.} \times 0.8 \times 4 \text{ degrees}} = 166 \text{ cu. ft.}$$

*Note:* The temperature range was limited to four degrees as this is the usual limit of thermostats. When manually-operated, the range can be raised to ten degrees or more if desired.

### The Problem Using a Direct Expansion System

We will now answer a hypothetical question. How should this problem be handled if it were necessary to use direct expansion instead of brine?

If the water temperature has to be kept within the four-degree range, it would then be necessary to use a compressor having a capacity of four tons, which would bring the compressor line very close to the peak line *B-B*.

If, however, a more liberal temperature

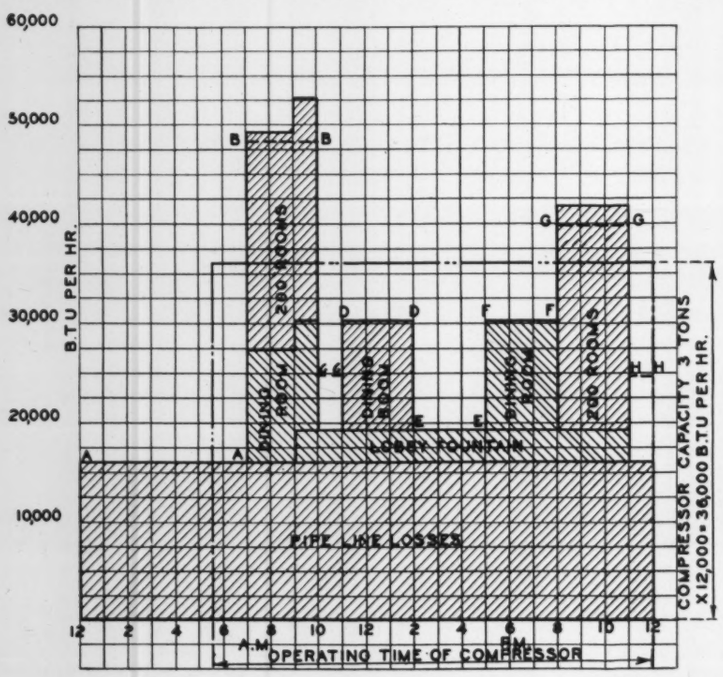



DIAGRAM NO. 1—THERMAL LOAD DIAGRAM FOR A HOTEL DRINKING WATER SYSTEM. ATMOSPHERIC TEMPERATURE, 110 F; CITY WATER TEMPERATURE, 80 F; DRINKING WATER TEMPERATURE, 40 F. 100 GALS. FOR DINING ROOM SERVICE PER MEAL; MEAL HOURS, 7 A.M. TO 10 A.M., 11 A.M. TO 2 P.M., AND 5 P.M. TO 8 P.M. LOBBY FOUNTAINS, 10 GALS. PER HR., 9 A.M. TO 11 P.M. ROOM SERVICE, 200 GALS., 7 A.M. TO 10 A.M. AND 8 P.M. TO 11 P.M.

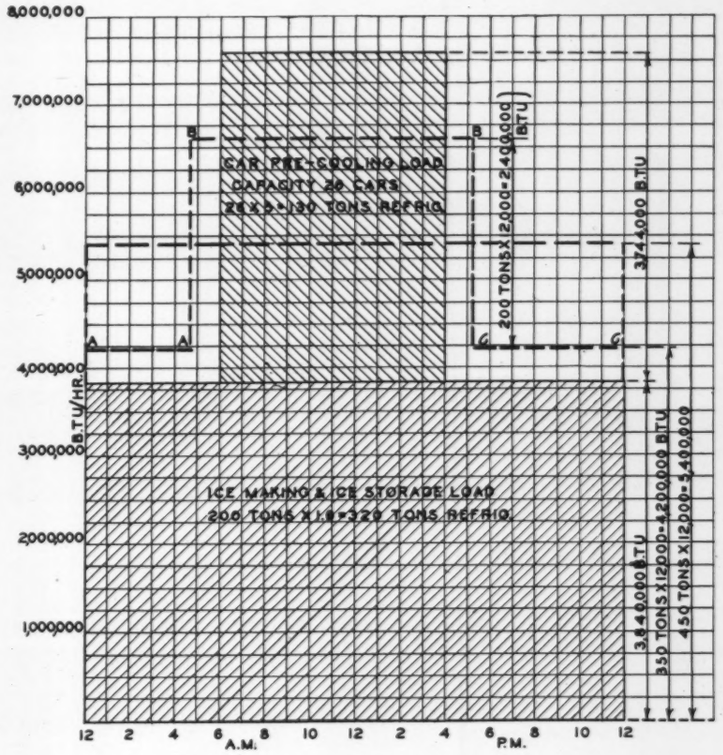



DIAGRAM NO. 2—THERMAL LOAD DIAGRAM FOR AN ICE-MAKING AND CAR PRE-COOLING PLANT

range is permissible, we can find out readily from our diagram what the temperature rise would be and, for sake of illustration, we will see what the temperature rise would be should we use a three-ton compressor.

The water temperature at 7:00 a. m., or at the beginning of the peak, is 40 degrees; at 10:00 a. m., the water would be at a temperature of 72½ degrees. This is found as follows:

Area above compressor line equals 43,100 B.tu.

$$\frac{43{,}100 \text{ B.tu}}{160 \text{ gal.} \times 8.3 \text{ lb.}} = 32.5 \text{ degrees.}$$

Initial water temp. = 40.0
Temperature rise = 32.5

Temperature at 10:00 a. m. = 72.50

It is very evident that this condition would be impractical; therefore, a larger compressor would be necessary. It is also very evident, by studying the diagram, that a constant-speed compressor operating at a constant suction pressure would have short and frequent operating periods when operating automatically. Power could be saved by varying the suction pressure in order to vary the compressor capacity. This could be accomplished either manually or by the use of a load demand valve instead of using a pressure actuating feed valve.

Diagram No. 2 is a thermal load diagram of an ice making and car pre-cooling plant. This is a very simple diagram and the notes on this diagram are sufficient explanation to show how the thermal load was plotted. The car pre-cooling is done during a ten-hour period. We will see what size brine tank is necessary to take care of the pre-cooling load. The shaded area above the compressor line represents the thermal load to be stored, and in our case equals 2,184,000 × 10 hours or a total of 21,840,000 B.tu.

$$\frac{21{,}840{,}000 \text{ B.tu}}{75 \text{ lb.} \times 0.8 \times 15 \text{ deg. rise}} = 24{,}266 \text{ cu. ft.}$$

As this is a rather large brine tank, it would be more practical to have larger compressor capacity so arranged that one compressor could be cut out after the pre-cooling load is taken care of.

We will see what size brine tank would be necessary if we had a compressor capacity of 350 tons with an extra compressor of 200 tons capacity to be used for the pre-cooling load. The compressor line would then be as shown by dotted line *A-A, B-B* and *C-C*. The area of the load above line *B-B* equals 9,840,000 B.tu.

$$\frac{9{,}840{,}000}{75 \text{ lb.} \times 0.8 \times 15 \text{ deg.}} = 10{,}930 \text{ cu. ft.}$$

This is a more practical size of tank, although there are other factors that should be considered before a final solution is arrived at. The intent of this article is merely to show how the diagram can be used to help solve these problems, and, of course, there are many more uses for this form of diagram.

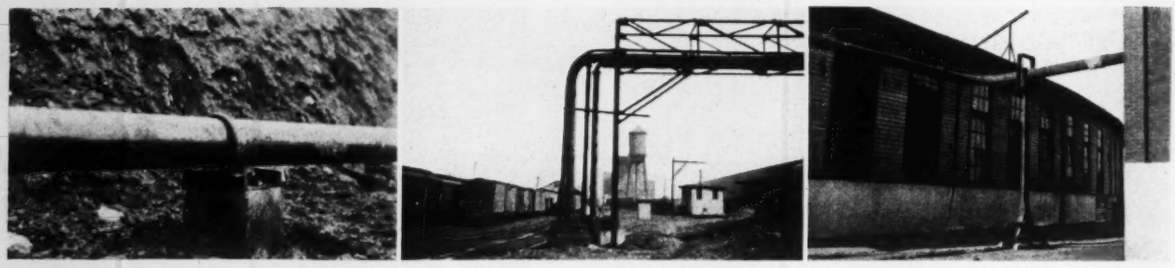
## Principle of Regulating Valves

Reducing or regulating valves are of many different kinds, but the principle of operation is similar. The pressure on the outlet side of the valve, or the pressure to be controlled, is used in some way to operate and control the valve.

Reducing valves, as a general rule, are governed by the delivery pressure. When the delivery pressure rises to the proper point for which the valve is adjusted, the power from this pressure furnishes the means for closing the valve.

The controlling pressure for reducing and regulating valves is not always the pressure on the outlet side of the valve. For example, a pressure governor for a steam-driven pump is a type of regulating valve and the controlling pressure is taken from the pump discharge line,—in case of a water pump the pressure control pipe would carry water pressure. A rise in water pressure in the pump discharge line would be conveyed through the pressure control pipe to the diaphragm chamber of the regulating valve and this pressure, acting on the diaphragm working against a spring or weight resistance, would have a tendency to close or partly close the regulating valve furnishing the steam to operate the pump. By regulating the steam supply to the pump the speed of the pump can be controlled which will, in turn, control the water pressure in the pump discharge lines. A regulating valve of this type is generally referred to as a governor.—*W. H. W.*

# Steam, Water, Air and Oil Piping for Railroad Yards



FIGS. 1, 2 AND 3—(LEFT TO RIGHT). CLOSE-UP OF PART OF A COMPLETELY WELDED DISTRIBUTION LINE. TWO VIEWS OF TYPES OF OVERHEAD CONSTRUCTION

PIPING for railroad yards in this discussion covers steam, water, air and oil, named in order of their importance. Steam is required for heating cars in the yards, running auxiliary equipment, sterilizing, front protection and snow melting coils, also for heating different buildings which are often scattered about the yard. The steam piping for yards should be so laid out that the mains run to a central point of distribution, and it is a good practice, if it is possible to do so, to have a ring header or modified ring header around the yard, so that if there is a break in one section, the other sections of the yard can be supplied. If the steam service main is run from the boiler header to a point of distribution in the yard, and is not cross connected with another steam main, a break in this line might cause considerable damage during severe winter weather if steam were shut off from cars for several hours.

If only one distribution line is installed for a certain section, some railroads install valves so that these sections can be isolated in case the distribution line fails or has to be shut down for repairs, and connections are provided at regular points so that locomotives can be attached to provide steam for these sections. Also, by cross-connecting steam mains, better pressure can be maintained through the yards with smaller lines. It is hardly probable that the entire yard will be on a peak load at the same time, as most yards are so laid out that switching is done in different sections and it is necessary to leave cars on certain sections for some time so as to make repairs and clean the equipment.

Piping for yard distribution is installed overhead,

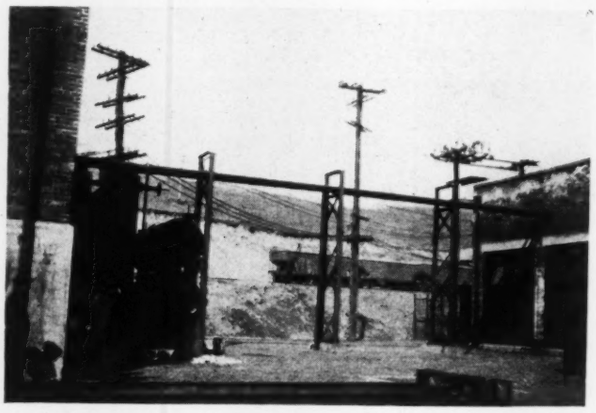


FIG. 5—"A" FRAME SUPPORTS CARRYING AN OVERHEAD LINE

FIG. 4—OVERHEAD LINE SUPPORTED ON STEEL TOWERS

underground in tunnels or conduit, or in open trenches on the surface of the ground, or under walkways or platforms. Steam service for yards is the most important and is also the most difficult to maintain.

Fig. 1 is a photograph of a recently installed completely welded 6-in. diameter distribution line, supported on concrete piers provided with rollers for expansion. This line is approximately 24 in. above ground. A metal jacket was provided to protect the insulation. After welding, a test was applied to this line and all joints found to be perfectly tight. Welded lines are now extensively used, and pipe manufacturers are furnishing without extra charge, chamfered pipe ready for welding.

Water, air and oil piping in yards can be installed in trenches, or in most any location available. Steam lines however, have to be provided with insulation; also moisture must be kept away from them. If

efficient distribution is desired, expansion and contraction must be taken care of, besides proper draining of the lines by steam traps or open blow.

### Overhead Steam Lines

The overhead construction for steam lines is used extensively, and is probably the cheapest, considering all factors. It can be inspected easily, repairs can be made quickly, no drainage is required, and by using weatherproof insulation, the heat loss is not high. Figs. 2, 3, 4 and 5 are pictures showing various types of overhead construction.

There is however, a danger on overhead lines of damage due to derailments or wrecks, but this is not very likely to happen in yard services where train speeds are low. It is often possible to install these lines under canopies or along the sides of a building, thereby keeping them away from the tracks. Pipe tunnels probably provide the most satisfactory method of handling yard services. Tunnel construction is very expensive, and for that reason is not used to a great extent, except in large terminals. Tunnels also serve for purposes other than for the installation of a yard service, that is, they can be used as walkways for different sections of the yard, thereby eliminating the danger of men crossing tracks. Tunnels must be kept dry, and if the yards are located in wet places below the drain lines or sewers, it means that sump pumps have to be installed to take care of the tunnel drainage. However, this is not much of a disadvantage, because drains should be provided for all forms of underground installation.

Drainage for underground conduit should have tile set in loose stone. This tile should be at least 6 in. in diameter, or have an effective area equal to a 6-in. tile.

It is difficult to drain underground lines properly, on account of the accumulation of water on the surface of the ground which runs into these conduits, even for yards that are well drained. This accumulation of water is caused by snow melting on cars, water running off from cars when they are being washed, and water accumulation on the ground from rain or snow. A number of railroad yards have the steam lines laid in trenches, these trenches being lined with wood, concrete or other material, and often the lines are laid in dirt trenches. While the first cost of this construction is low, it is expensive to maintain and it is almost impossible to properly drain these trenches, and in time, the service lines are lying in mud and water, and the heat loss from

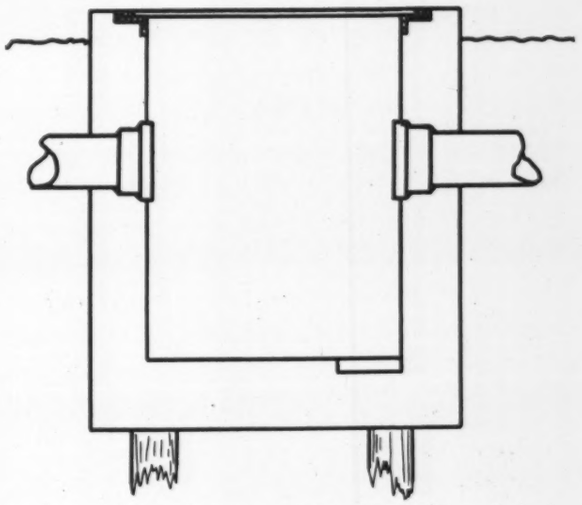


Fig. 6—Method of Securing Water Pipe in Concrete Pit

these lines is very high. The condensate is also carried along with the steam into train lines, and this causes serious trouble during severe winter weather. Steam lines are sometimes made up and then laid or dropped into these trenches, and it is almost impossible to maintain such lines. Steam lines installed under walkways or in wooden trenches on the surface of the ground, having concrete or wooden covers, is good practice for distribution lines through the yards. This type of construction is used by a number of railroads and besides furnishing trenches for steam lines and other services, it also provides walkways for employes. Where this type of construction can be used, it is probably the most popular among railroad men.

Where it is necessary to install underground lines in swampy or poorly drained locations, and where tide water or river levels are above pipe systems, a very effective type of conduit is used, consisting of cast iron water pipe, caulked tightly at joints. Concrete pits can be erected at various locations for installation of steam traps, separators, expansion joints and connections for drainage lines. A typical section of pit is shown in Fig. 6, which also shows the method of securing cast iron water pipe conduit in the cement. Fig. 7 is a photograph of such an installation.

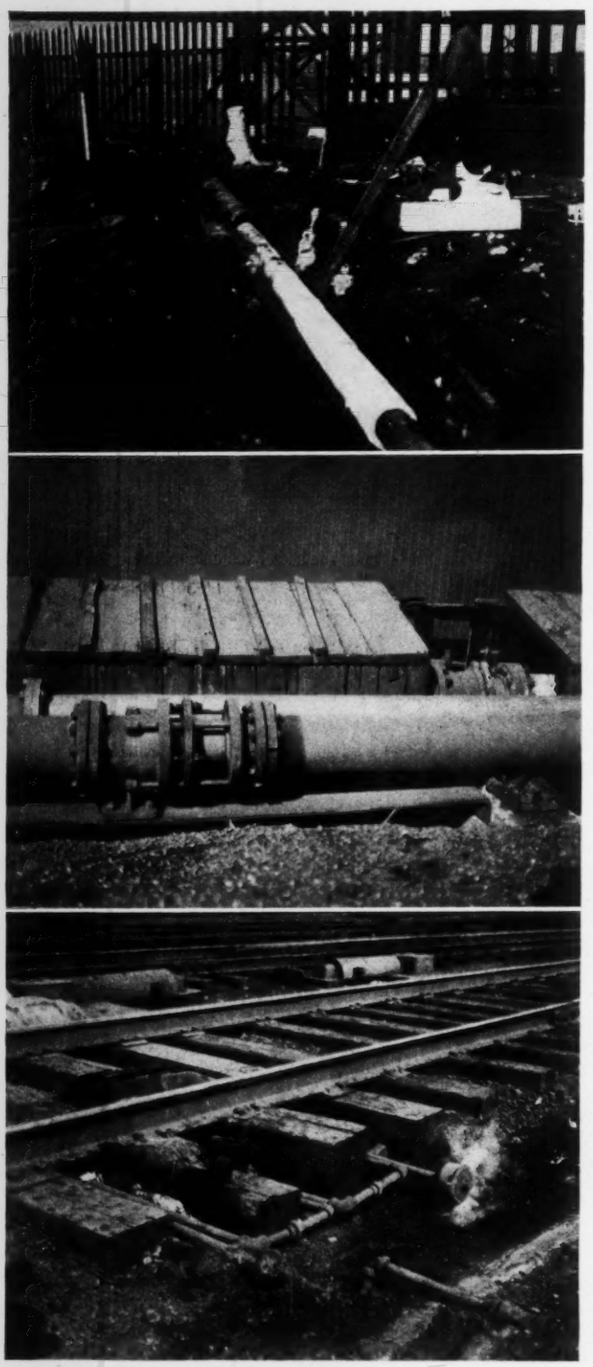
No trouble should be experienced in installing the pipe inside of the cast iron conduit. It is recommended that joints for this type of construction be

Figs. 7, 8 and 9—(Left to Right). Concrete Pit for Traps and Separators. Two Views of Construction of Conduit for Underground Steam Lines

welded and tested in sections, after which the insulation and conduit can be slipped on the pipe. Some railroads use steel pipe with welded joints instead of cast iron pipe. Figs. 8, 9 and 10 are photographs showing the construction of cast iron conduit for underground steam lines.

### Expansion and Contraction

Expansion and contraction for these distributing lines is taken care of by pipe bends, corrugated expansion joints, slip joints and offset fittings.



FIGS. 10, 11 AND 12—(TOP TO BOTTOM). CAST IRON CONDUIT FOR UNDERGROUND STEAM LINE. A SLIP TYPE EXPANSION JOINT, SHOWING ANCHOR AND TRAVEL LIMIT BOLTS. SNOW MELTING COIL APPLIED TO DERAIL

The corrugated expansion joints are used for small expansions up to 2 or 3 in., but with the slip joints a maximum expansion up to 10 in. can be obtained.

The linear expansion of any length of pipe is determined by calculating the difference between minimum surrounding temperature and the highest temperature of steam, gases, or liquids to be conveyed through the pipe. The table below, recommended by the association, shows the expansion in 100 ft. of pipe at various temperature differences.

INCHES OF LINEAR EXPANSION IN 100 FT. OF PIPE

| TEMP. DIFF., DEG. F. | WROUGHT IRON | STEEL | CAST IRON | COPPER AND BRASS |
|---|---|---|---|---|
| 0 | .00 | .00 | .00 | .00 |
| 10 | .08 | .08 | .05 | .13 |
| 20 | .15 | .15 | .10 | .25 |
| 30 | .23 | .23 | .15 | 35 |
| 40 | .30 | .30 | .25 | .45 |
| 50 | .40 | .38 | .36 | .57 |
| 100 | .79 | .76 | .72 | 1.14 |
| 125 | .97 | .92 | .88 | 1.40 |
| 150 | 1.21 | 1.15 | 1.10 | 1.75 |
| 175 | 1.41 | 1.34 | 1.28 | 2.04 |
| 200 | 1.65 | 1.57 | 1.50 | 2.38 |
| 225 | 1.87 | 1.78 | 1.70 | 2.70 |
| 250 | 2.09 | 1.99 | 1.90 | 3.02 |
| 275 | 2.36 | 2.26 | 2.15 | 3.42 |
| 300 | 2.58 | 2.47 | 2.35 | 3.74 |
| 325 | 2.86 | 2.73 | 2.60 | 4.13 |
| 350 | 3.08 | 2.94 | 2.80 | 4.45 |
| 375 | 3.46 | 3.31 | 3.15 | 5.01 |
| 400 | 3.63 | 3.46 | 3.30 | 5.24 |
| 425 | 4.05 | 3.86 | 3.68 | 5.85 |
| 450 | 4.28 | 4.08 | 3.89 | 6.18 |
| 475 | 4.62 | 4.41 | 4.20 | 6.68 |
| 500 | 4.90 | 4.67 | 4.45 | 7.06 |
| 525 | 5.22 | 4.99 | 4.75 | 7.55 |
| 550 | 5.55 | 5.30 | 5.05 | 8.03 |
| 600 | 6.26 | 5.98 | 5.70 | 9.06 |
| 650 | 7.05 | 6.71 | 6.40 | 10.18 |
| 700 | 7.86 | 7.50 | 7.15 | 11.37 |
| 750 | 8.75 | 8.36 | 7.96 | 12.66 |
| 800 | 9.76 | 9.31 | 8.87 | 14.10 |

All distribution lines must be anchored properly and should be isolated from track structures which are subject to shocks due to train movements. Service connections from the yard distributing lines to the train steam lines are the most expensive and difficult to maintain of all services. These services are either of the flexible metallic joint or rubber hose connection, and in most cases, exposed to the weather and also are likely to be damaged when trainmen fail to disconnect before moving cars. These services are most generally taken off from the main line that runs along the bumpers, and it is bad practice to have these steam lines or services connected to the bumpers which are likely to be damaged due to heavy shock from trains hitting the bumpers. Cases have been known where these bumpers have been moved a considerable distance and have broken the steam line. Also, the breaking of these lines is likely to injure employes or persons near the location where the lines are broken. The same thing applies to compressed air lines. The damage resulting from a break in a water line is not so serious as for a steam or air line.

When air-operated car retarders are employed in freight classification yards to control the speed of

| Item | Test No. 1 | Test No. 2 | Test No. 3 |
|---|---|---|---|
| Outside temperature, deg. Fahr | 32 | 31 | 32 |
| Steam pressure at trap | 63 lb. | 63 | 52 |
| Duration of test (minutes) | 15 | 9 | 15 |
| Heating surface of snow melting coil | 50.49 sq. ft. | 50.49 | 45.27 |
| Pounds of condensate test period | 19.959 | 12.9 | 15.836 |
| Pounds of condensate per hour | 79.8393 | 86.054 | 53.345 |
| Pounds of condensate per sq. ft. of coil surface per hr | 1.58 | 1.7 | 1.39 |

cars, considerable damage would result in the event of an air distribution line failure. It is recommended that a check valve be used close to the yards to prevent a back flow of air draining the system and allowing retarders to be inoperative, resulting in runaway cars, should a failure occur while cars are being dispatched. Some railroads use a combination stop and check valve, the same as used on power plant boilers.

### Frost Protection of Water Lines

There are a number of yards requiring frost protection for water lines, the frost protection consisting of running small steam lines along water lines; then the proper installation of the water lines is almost as important as steam lines.

Steam lines are installed by some railroads to melt the snow around switches, and the table above is a result of three tests made during a snow storm on two different switches using steam for melting the snow.

The tests were made to determine the amount of condensate per hour on this type of service. Snow melting coils are generally more subject to corrosion than other services in the yard. Fig. 14 shows three stages of corrosion of nipples in snow melting coils. The first sample had been in service 8 months, the second, 19 months, and the third, 27 months. The 27-month sample had one end broken off when removing it from the fitting.

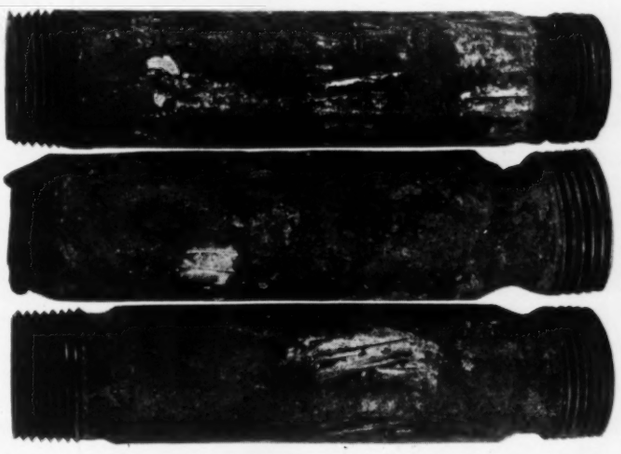


Fig. 14—Three Stages of Corrosion of Nipples in Snow Melting Coils

Fig. 13—Snow Melting Coil Applied to a Switch

Fig. 15 shows the location of pitting when nipples are in service. These nipples were made from extra heavy galvanized pipe cut from commercial lengths, and it will be noted that the corrosion started where the threads were cut on pipe exposed to weather outside of the fitting.

Fig. 15—Location of Pitting in Nipples

### Valves

The valves for distribution lines in yards should be of heavy construction, and also so designed that they can be repaired quickly. The steam valves are subject to hard usage, are handled by all classes of labor and are allowed to wire draw, which will cut valve seats very quickly on account of the high percentage of moisture that these lines carry. Valves for water, air and oil lines should also be of heavy construction and easily maintained. Valves and accessories for all distributing lines should be so installed that employes or persons walking through the yards are not likely to fall over them thereby causing injury.

### Pipe Joints

Pipe joints for steam distributing lines and service for the different facilities are of the following types; screwed couplings, screwed flanges, Vanstone and reinforced welded joints. Reinforced welding is a good method, as is the Vanstone type. A screwed coupling, welded at both ends, makes a good joint.

Pipe bends can be used when changing the direction of the run, and outlets for each service can be welded. This is done to eliminate joints and make it easy to install the pipe covering. Fittings, when required, should be of steel instead of cast iron, on account of the higher tensile strength and ability to weld the joint in case of a leak at the thread. Fig. 16 shows a 12-in. steam line with Vanstone fittings, etc. It is not always a question of the pressure applied to the fittings, but these lines are

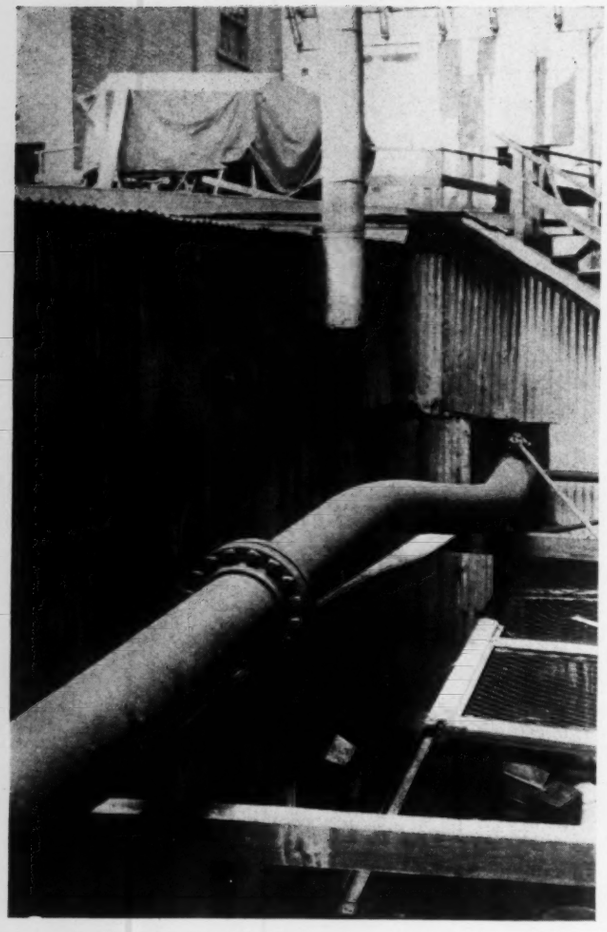


FIG. 16—TWELVE-INCH STEAM LINE WITH VAN STONE FITTINGS

subject to greater stresses than any other class of service in railroad work, with the possible exception of locomotive piping.

### Oil Piping

Oil lines are being installed in some railroad yards to take care of Diesel or oil fired locomotives, and possibly other equipment about the yard. These lines usually do not carry very high pressure, and can be installed similar to water lines, although there is a question regarding the insulation of these lines, and also protection from electrolysis.

This information was abstracted from a paper presented at the 1929 annual meeting of The International Fuel Association by the committee on stationery power plants, chairman, William Oleson, supervisor of power plants, New York Central Railroad, New York, N. Y.

## Activities of *A. S. T. M.* Committee A-1

During the year 1929 the activities of Committee A-1 on Steel have been in broadening, correcting and clarifying existing specifications; outlining programs for the development of new specifications; and in two instances, providing new tentative specifications.

Sub-Committee I on Steel Rails and Accessories has taken steps towards the creation of a Joint Committee with the *A. R. E. A.* for the drafting of a new specification covering a product known to the trade as Intermediate Manganese Rails.

Sub-Committee II on Structural Steel for Bridges, Buildings and Rolling Stock has carried on the outline presented in 1928 for consideration of the subject of Increased Tensile Requirements for the Structural Steel Grade and the consideration of the restriction of use of Bessemer Steel on this grade, and has obtained as a basis for consideration the reactions of organizations interested in all phases of the subject.

Sub-Committee IV on Spring Steel and Steel Springs, with the co-operation of members of the *Railway Manufacturers' Technical Committee* and the Sub-Committee on Springs of the *A. R. A.*, has progressed towards a tentative specification for Specially Heat Treated Helical Springs now offered, the basis being a demand from large consumers' organizations for a working basis in the purchase of this product.

Sub-Committee V on Steel Reinforcement Bars.—In connection with the subject of Steel Reinforcement Bars the joint committee of Committee A-1 and C-2 on Tests for Reinforced Concrete has laid out a program of investigation in which Sub-Committee V through individual membership on the joint committee will consider subjects regarding methods of tests relating to the sub-committee's program.

Sub-Committee VI on Steel Forgings and Billets has brought to a conclusion the results of a mass of investigation regarding the necessary reduction from ingot to bloom, resulting in a revision of existing standards. The pertinent details of this investigation have been presented by Mr. Fry, a member of the Sub-Committee, in a paper before the Society.

Sub-Sub-Committees are investigating methods of tests with particular regard to speed of testing as affecting the yield point, after the completion of which they will consider the preparation of revisions to existing standards for Carbon Steel and Alloy Steel Forgings Quenched and Tempered, Carbon Steel Axles, Shafts and Other Forgings.

A Special Sub-Sub-Committee on Alloy Steel Tubing, under the direction of Sub-Committee IX on Steel Tubing and Pipe, reports that practice in this industry has not sufficiently developed to make it practical to at present prepare specifications. The committee is being continued with instructions to collect data and report.

Another Special Committee, of Sub-Committee IX, to develop ways and means of developing specifications for all classes of pipe and tubing such as fusion and resistance welding, hammer welded, and all classes of fabricated pipe, has been formed with the request to report progress at the next Sub-Committee meeting.

Sub-Committee XI on Boiler Steel, is working in conjunction with the *A. S. M. E.* Boiler Code Committee in the preparation of Specifications for so-called Open Hearth Pure Iron Boiler Plate.

Sub-Committee XIX on Sheet Steel and Steel Sheets, through a sub-committee, is investigating and will draw up a new specification covering steel sheets for freight cars.

Approval of advancement of Tentative Specifications for Cold-Rolled Strip Steel (A 109-27 T) has been withheld until final tests are obtained on a new type test bar now being investigated.—V. H. Lawrence, *Secretary.*

# Cooler-Humidifier for Producer Gas

*By* Linn B. Bowman

IN THE manufacture of producer gas it has been common practice in the past to pass the producer gas through waste heat boilers to recover the sensible heat of this gas. This process involves certain investments and costs; namely:

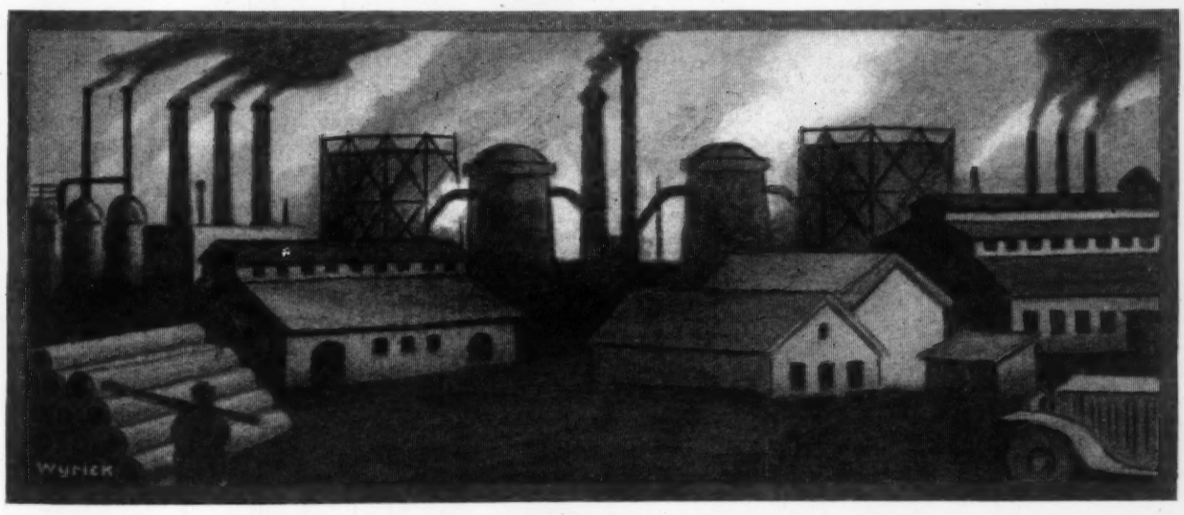
1. The investment cost of a waste heat boiler for each producer, whether it be in operation or acting as a spare.
2. The cost of maintenance of the boiler proper, water columns, try cocks, gages, boiler inspectors, valves and all other boiler accessories.
3. The boiler must be taken out of service at least once a year for overhauling and inspection by the boiler inspector.
4. Insurance must be carried on each boiler.
5. In case of trouble with a boiler the producer and boiler must both be taken off the line.
6. Operating labor must also be included for watching the water columns.
7. Boiler water purification is necessary.

With the above facts in mind and knowing that the sensible heat in the producer gas made is practically the same as the heat required as endothermic in the primary air blast, an effort was made to devise some simple means by which the sensible heat in the producer gas could be cheaply transferred back into the primary air blast, using the steam so made in prime movers and then in turn using the exhaust steam for the primary air. As a result, the cooler-humidifier was developed to fulfill these conditions.

This producer gas cooler-humidifier at the West Station gas plant of the Rochester Gas & Electric Corporation, Rochester, N. Y., consists of a tower seventy feet in height and eight feet in diameter. The lower section of this tower is made of three-eighth-inch steel plate and the upper section is made of one-quarter-inch steel plate. The tower is divided into three separate compartments. The upper compartment is used for cooling and scrubbing the producer gas with water; the middle compartment is open to the atmosphere and contains two seal pots through one of which the water from the upper or cooler section must pass before the water can be admitted to the lower or humidifier section. This middle compartment also contains the spray line headers for the humidifier section. Two seal pots are provided so that repairs or cleaning can be done on one seal pot while the other is in operation, thus providing for continuity of operation. The lower compartment is used for saturating with water and preheating the primary air which is used in the manufacture of producer gas.

The upper or cooler compartment is thirty-five feet in height and is brick lined on the bottom while the shell is brick lined for a distance of seven feet from the bottom. This brick lining is put in to protect the steel shell from the heat of the incoming producer gas which enters the cooler at a rate of approximately three hundred and fifty thousand cubic feet per hour near the bottom through a sixty-six inch brick lined steel pipe. The average temperature of this gas is 950 deg. fahr. at the point that it enters the cooler. After being cooled in this section the gas leaves the tower near the top through a forty-two inch steel main. This main is not lined since the average temperature of the outgoing gas is 130 deg. fahr.

Water at atmospheric temperature is pumped through sprays in the top of the cooler section by means of a centrifugal pump. This water enters the cooler through five sprays in the top of the cooler and one spray near the bottom of the cooler in the path of the flow of the incoming gas. This spray acts like a fountain in the gas stream. After cooling and scrubbing the producer gas, the water leaves the cooler section of the cooler-humidifier at an average temperature of 146 deg. fahr. through an eight-inch outlet pipe which dips into a seal pot in the middle section of this tower. The over-flow of this seal pot is connected to the spray headers for the humidifier section of this tower. The water is



sprayed into the top of the humidifier section through four baffle sprays. The humidifier section is partially filled with wood hurdles to provide better contact between the air which is drawn in at the bottom of the humidifier and the water from the sprays. This air drawn into the humidifier is at atmospheric temperature and only partially saturated with water vapor. As it passes upwards through the wooden hurdles counter-current to the incoming water it becomes saturated and heated until as it leaves the humidifier section it is at a temperature of approximately 125 deg. fahr. The water goes from the bottom of the humidifier into a sump at an average temperature of 99 deg. fahr. and from there to the sewer.

This cooler-humidifier was placed in operation in May, 1927, and has been in operation continually since that time with practically no trouble. We have been cooling and scrubbing the producer gas from three 8 ft. 6 in. producers gasifying about twenty-four tons of coke per twenty-four hours per machine using a saturation temperature of 144 deg. fahr. for the primary air blast. The humidified air is blown through the grates and thence through the fire of the producer. As before stated, the air as it leaves the humidifier is saturated with water vapor at 125 deg. fahr. Then, after passing through the blower, enough low pressure steam is added to this air to bring the saturation temperature to 144 deg. fahr. The producer gas made carries along with it a small quantity of very fine coke dust which is also washed out in the cooler section of the cooler-humidifier. This fine dust partially settles out in the seal pot of the middle section of the tower. This necessitates changing over seal pots periodically so as to flush out the fine coke to keep it from plugging the seal and cause the cooling water to build up in the cooler section.

A twelve-day heat balance was run on this equipment under the following conditions:

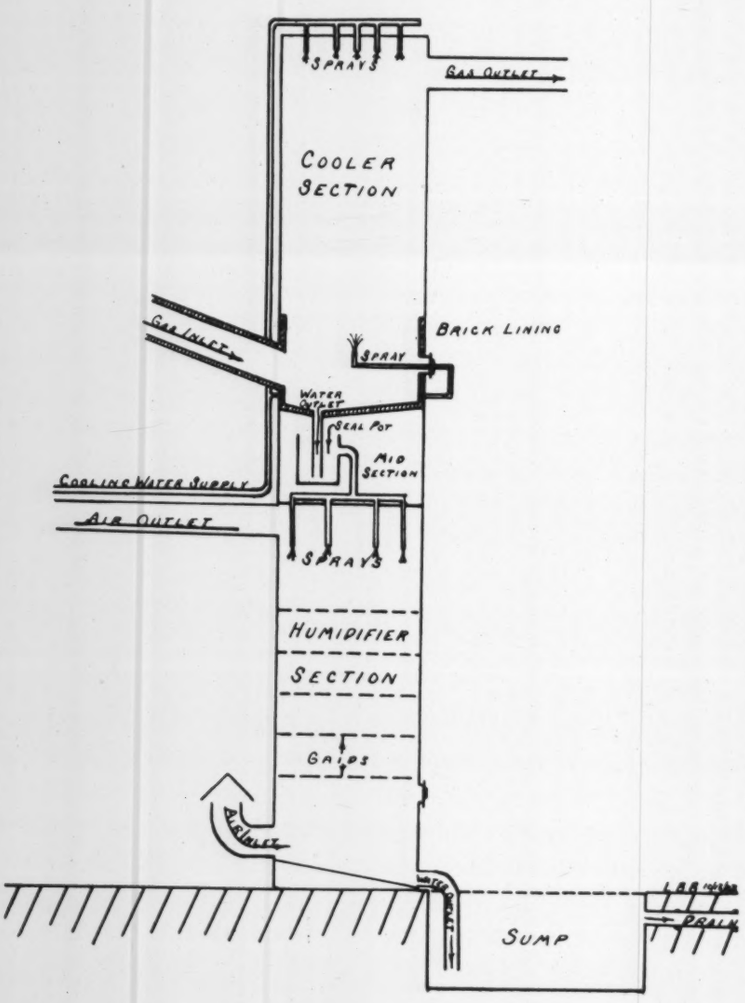
| | |
|---|---|
| Volume of dry producer gas cooled and scrubbed, cu. ft. | 99,166,694 |
| Temperature of inlet gas, deg. fahr. | 952 |
| Temperature of outlet gas, deg. fahr. | 129.1 |
| Volume of cooling water used, gal. | 1,715,122 |
| Temperature of inlet water to cooler, deg. fahr. | 70.51 |
| Temperature of outlet water from humidifier, deg. fahr. | 99.34 |
| Temperature of inlet air, deg. fahr. | 69.2 |
| Humidity of inlet air, per cent | 64 |
| Temperature of outlet air, deg. fahr. | 124.41 |
| Humidity of outlet air, per cent | 100 |

Under the above conditions the heat losses in this piece of apparatus were due to the following items:

1. Difference in temperature between the incoming and the outgoing cooling water. This equaled 25.1 per cent of the total heat given up in the cooler section by the producer gas.
2. Radiation equaled 4.04 per cent of the total heat given up in the cooler section by the producer gas.
3. Convection equaled 3.56 per cent of the total heat given up in the cooler section by the producer gas.

The only trouble that has been experienced with this piece of apparatus has been corrosion of the shell of the cooler section. The cooler section of this tower has no hurdles for making a greater cooling surface. To keep the water from the sprays from running down the sides of the cooler, steel deflector plates were built so as to throw the water that runs down the sides into the center part of the cooler. Under these deflector plates there is a band about six inches wide that is not wet by the water from the sprays. This is due to its being protected by the deflector plate. The conditions were just right so that one of these protected bands around the tower corroded away. This corrosion was first thought to be erosion from spray water impurities but on studying the location of the trouble and a comparison of the oxygen content of the producer gas entering and leaving the tower it became evident that it was corrosion

PRODUCER GAS COOLER-HUMIDIFIER



due to dissolved oxygen in the cooling water which entered the top of the tower. As this cooling water became warmer due to absorbing heat from the producer a large portion of the dissolved oxygen was driven out of the cooling water into the producer gas. Then corrosion took place due to this oxygen wherever there was metal exposed that was not being washed by the cooling water, temperature conditions being just right. A peculiar situation, however, is that the corrosion is very local being only a zone of 3-4 feet in the height of this tower and just above the spray line. Beyond this point no evidence of corrosion has shown itself. As soon as the condition was discovered, a thick steel band about thirty inches wide was welded to the outside of the tower making it as good as new again although not stopping the corrosion.

We have under construction at the present time another cooler humidifier for cooling additional producer gas for underfiring a new battery of ovens. The cooler section of this tower will be painted on the inside with a bitumastic material and tile lined at the corrosion zone which has been described above. It is expected that this will eliminate the corrosion trouble. The bottom of the cooler section will be filled for about six feet above the inlet gas pipe with spiral tile. Above the spiral tile will be installed wooden hurdles. The spiral tiles and wooden hurdles will eliminate the deflector plates that were used before on the original cooler and also give much better cooling due to increased cooling surface.

In case of a failure of the water supply, the hot incoming producer gas would warp the steel tower. To guard against this in our original cooler-humidifier, we installed four sprinkler heads in the top of the cooler section that would cut in high pressure city water whenever the temperature of the outgoing gas reached 286 deg. fahr. These sprinkler heads have had occasion to work several times and have proved very successful. In our new cooler-humidifier these sprinkler heads will be located between the spiral tile and the wooden hurdles in the cooler section.

The only other changes in design are an increase in the diameter of the tower from eight feet to nine feet to obtain additional capacity and an increase in height of six feet of the humidifier section to cut down the heat loss due to the difference in temperature between the incoming and outgoing water.

# Selection of Material in Welding Pressure Vessels

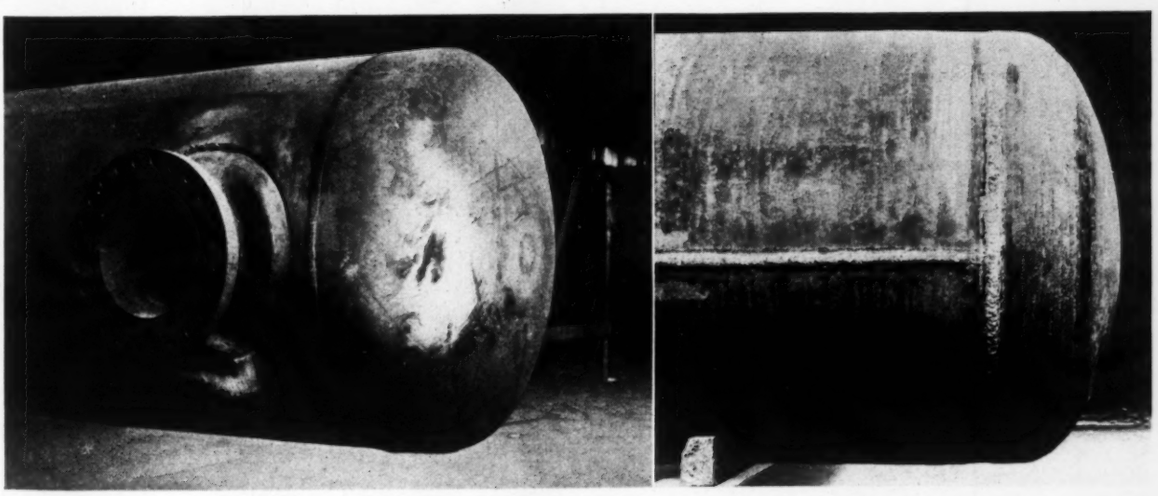
EXPERIENCE has shown that steel plate for welding should be specified on the basis of chemical composition, strength and quality.

It is well known that any plate that has to be heated locally or subjected to local mechanical work in the course of its fabrication should be made of low carbon steel, because the greater ductility of this material tends to minimize distortion and the development of local stresses. Welding involves local heating and also produces a certain amount of local stress which is equivalent to local mechanical work. Consequently, low carbon steel plate is preferable for welding. It is generally agreed that a carbon content of not more than 0.20 per cent should be specified up to ¾-in. plate and 0.22 carbon for plate that is more than ¾ in. in thickness.

Quality as applied to steel plate is a rather indefinite but nevertheless important term, referring particularly to the care with which the steel was made. Steel of good quality is free from impurities of various kinds. Care has been taken that the ingot molds are clean and of the best types, and in every way the steel has been well made.

### Qualities of Plate

Steel plate is made in four usual qualities: firebox, flange, ship, and tank. Firebox is the highest quality and is consequently specified for much pressure vessel work. In addition, the steel mill is informed that the plate is to be welded so that special care will be taken in selecting the material that is shipped to fill the order.



RIGHT—PLAIN HEAD ON 7 FT. BY 35 FT. TANK. LEFT—REINFORCED NOZZLE WELDED INSIDE

# Low Temperature Insulation as Applied to Piping Systems

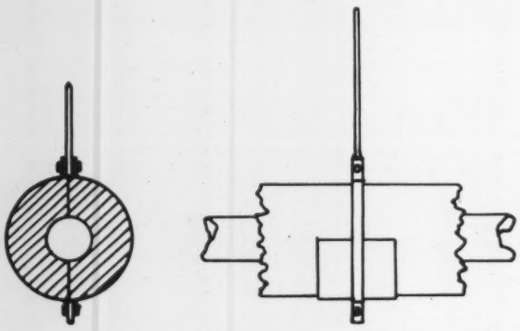
*By* C. T. Baker

SINCE the very beginning of things in the ice and cold storage industry, nearly every one has agreed that insulation in some form or other is very necessary for piping systems through which low temperature refrigerants are circulated.

Unfortunately, however, educating the user on the necessity for the proper application and maintenance of low temperature pipe covering has been a slow and rather laborious task on the part of those who have endeavored to instruct, consequently the cold storage industry still continues to pay tribute to the wildcat B.tu that slips back into the refrigerating fluid or gas, as the case may be, after having been ejected earlier in the refrigerating cycle, usually at considerable cost.

Just why this is so is not difficult to answer if one will but take the time to investigate a few of the plants that suffer from loss in capacity and power due to heat leakage.

In this article an effort is made to indicate the principal reasons for these losses and to offer some advice



FIGS. 1 AND 1A—A METHOD OF SUPPORTING INSULATED PIPE UP TO 3 INCHES IN SIZE WHICH IS QUITE GENERALLY USED

to those who might be interested in bringing about improvements.

### The Destructive Effects of Moisture

One of the principal causes of heat leakage losses in piping systems, as well as of deterioration of insulation, can be traced to moisture.

Pipe covering, to be efficient, must be so applied to pipe lines and so supported as to absolutely prevent moisture-laden air from coming in contact with the cold surfaces of the pipe after the covering is applied.

Wherever this occurs, the moisture of the air is reduced in temperature to the dew point, causing precipitation and ultimate freezing. The water so collected will, when freezing, expand and cause fracturing and often times bursting of the covering, since the force of this expansion must find an outlet.

Pipe insulation thus injured has a very short life, since the cracks and openings resulting from the first freezing will permit the easy entrance of air with its additional moisture which will result in further destruction due to freezing and thus the vicious cycle continues.

### Causes of Air Leakage

Investigation has shown that the cause of most trouble resulting from frozen moisture is found in the methods employed in the application of the insulation and in the methods of supporting the pipe lines.

In Figs. 1 and 1-a is shown one method of supporting insulated pipe lines that is quite generally used for pipe sizes up to and including 3-inch diameter.

It will be noted that a wide metal strap or band is so placed as to encircle the lower half of the covering and that a second, but narrow, band is passed entirely around both the covering and wide band and secured at the top to one end of a steel rod or hanger, the other end of which is secured to the ceiling or floor joists above or to other convenient points of suspension.

It is evident that, with the entire hanger placed outside the covering as shown, no air can reach the pipe as does happen when the mains are supported by means of a hanger fastened to the pipe proper and where the covering must be fitted to the pipe around the hanger.

It is almost an impossibility to make an air-tight joint between the covering and the hanger, where the hanger is fastened to the pipe direct, consequently this type of construction should be avoided wherever possible.

The foregoing applies to the various kinds of sectional molded covering especially.

Figs. 2 and 2-a show the trapeze-type hanger which is also excellent and which is used quite generally for supporting large diameter pipe mains.

The sheet iron shield should extend not less than four inches on each side of the hanger and must be so shaped to accurately fit the covering and should extend up the sides to the center line of the pipe.

### Necessity for Clean Pipe Surfaces

Too often, covering is applied to pipe surfaces that are not clean or free from foreign substances such as particles of dirt or lumps of mortar or cement that have fallen and stuck to the pipe surfaces during plastering operations.

Before any covering is applied, it is very important that all pipe lines be thoroughly cleaned, also that the inner surfaces of the covering be examined for foreign matter. If this is not done it will be impossible to fit the covering to the pipe properly.

### Testing for Leakage

It is very important that all pipe mains and laterals to be insulated be tested under pressure sufficiently high to show up any defective pipe or bad joints before the covering is applied.

If this is not done, any leakage that occurs after the system is placed in regular service will destroy the covering in time and will at once affect its insulating value.

Cold brine and ice water piping is usually tested under hydrostatic pressure, while gas and liquid lines are tested under air pressure. During the test, all piping and joints should be examined carefully for leaks, and any repairs or replacements necessary should be made before the insulation is applied.

### Kind of Covering

There are available several kinds of covering which may be used for insulating pipe lines. Some are the molded sectional covering, either of cork or other material, and some are what is known as the built-up hair felt.

In installations where the molded covering is used it is the better practice to insulate pipe mains larger than 8 inches with a lagging of the same material as that of the molded covering. This lagging of course must be beveled to the proper radius.

It is quite important in applying the molded covering, as well as the lagging, that all joints be cemented with water-proof cement and that the covering, or the lagging as the case may be, be held in place with copper clad steel wires with the wire bands placed on 6 to 8 inch centers.

It is very important also that all joints be drawn up tight all around the covering or lagging. Failure to apply the wire bands properly as mentioned has been responsible for the failure of many insulating jobs and too much stress, therefore, cannot be laid on the necessity for proper attention to these details.

There is another thing that is all too often neglected, and that is the care of the insulation after erection. After the pipe covering has been applied it is very necessary that periodic inspection of the wire bands be made and any broken ones replaced. Wire bands will break occasionally, no matter how well applied. Consequently, it is necessary that if the covering is to be maintained properly, periodic inspection must be practiced. One broken wire on a section of covering might easily cause serious trouble.

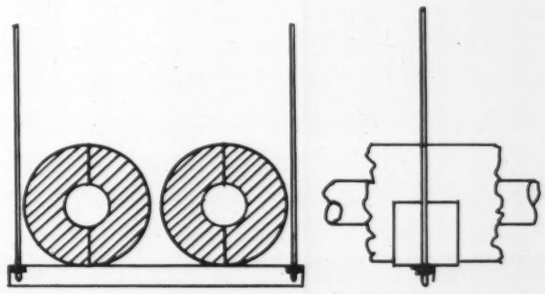
Another thing which is quite important, and which has resulted in much trouble in the case of the sectional molded covering, is that of the location of the longitudinal joints. Such joints should be on the top and bottom of the pipe and not on the sides, as is too often found to be the case.

Still another very important mistake found in many insulated pipe systems is the method employed of insulating the pipe where it passes through a wall. Too often the covering is simply butted up to the wall on each side with the joints between the wall and covering sealed with putty. This kind of construction is only a make-shift and has caused no end of trouble by permitting moisture to enter the space between the pipe and the covering.

Wall openings should be large enough to permit the covering to pass entirely through, and where the covering terminates on the inside of a room, like a cooler room, etc., the covering should project through the wall not less than three inches. The end of the covering should be carefully sealed around the pipe to prevent the entrance of moisture.

### Importance of Proper Pipe Spacing

When pipe lines that are to be insulated are being erected, it is quite important that proper clearance be



FIGS. 2 AND 2A—THE TRAPEZE-TYPE HANGER IS OFTEN USED TO SUPPORT LARGE-SIZE PIPES

allowed between centers of adjacent pipe lines to permit the covering to be applied without the necessity for reducing the thickness of the insulation.

Frequently, the walls of the covering are so cut away in an effort to reduce the thickness to where the existing space will allow the covering to be applied, that insufficient protection is provided against heat leakage and in many instances frost occurs on the surfaces where the covering has been cut away. This also occurs where pipe lines are located too close to walls, beams, etc.

The proper covering thickness required for any given case will depend upon the temperature of the refrigerant inside the pipes to be insulated.

In order, therefore, that proper pipe clearances may be provided, it is important that tables of pipe spacing for different thickness of covering provided by insulation manufacturers be consulted before any pipe work is laid out. This applies not only to the pipe lines but to the fittings as well.

Flange fittings, for instance, require considerably more room or clearance than screw pattern fitting, while both type fittings require greater clearance than the pipe lines to which they are connected.

The same rules that apply to pipe and fitting clearances apply equally well to cylindrical brine tanks, water filters, brine coolers, etc. Here, again, the necessary thickness of the lagging or other insulation used will depend upon the temperatures met with and therefore the spacing with reference to walls, etc., must be determined in accordance with these requirements.

A great deal more might easily be written on the subject of low temperature pipe insulation without exhausting the subject, but the intent of this article is only to draw attention to the necessity for the proper consideration of the many things all too often neglected in practice with the thought in mind that this would help to eliminate a great deal of trouble and expense that is all too common in the refrigerating industry.

# Balancing Inside-Outside Conditions

*By* Malcolm Tomlinson

Article No. 1

ANYONE who has had the experience of entering an air conditioned theater on a hot, humid day will not soon forget the sensation of coolness. To meet this situation air conditioning engineers, in the past few years, have planned their installations in such a way that they could be operated to furnish an inside temperature from 10 to 18 deg. fahr. lower than that outside. As an example, theater temperatures are maintained at 82, 80, 75 and 70 deg. fahr. dry bulb, respectively, when the outdoor temperatures are 100, 95, 85 and 80 deg. fahr. This adjustment is empirical and is planned to meet outside temperatures from 80 to 100 deg. fahr. For higher or lower outside temperatures, no adjustment is made. Naturally, as the dry bulb temperature is increased the relative humidity is lowered in order that a fairly constant degree of human comfort may be maintained.

### Balancing Inside-Outside Conditions for Winter Also Should Be Studied

No doubt this adjustment is planned to provide a comfortable condition in the summer months when theater patronage would, otherwise, be slim. Nevertheless it is evident that human beings feel an equal shock in winter months, on leaving a conditioned building, when atmospheric conditions inside and outside differ greatly. Since, in many countries where air conditioning is used, temperatures out of doors may vary from 40 deg. fahr. below zero to over 120 deg. fahr., for extreme weather conditions, it is evident that the subject of balancing these outside-inside conditions should be studied. Not only will the theater benefit through definite information on this subject but so will every other business which must use air conditioning.

Several years ago the writer had the experience of designing and operating a large room conditioned to ½ per cent relative humidity. A previous experience at 10 per cent had shown that a dry bulb of from 100 to 110 deg. fahr. gave a feeling of comfort. But 110 deg. fahr. at 2 per cent resulted in a chilly feeling and the dry bulb temperature of this ½-per cent room had to be raised to 120 deg. fahr. for comfort. The sensation on leaving each of these rooms to enter the unconditioned shop atmosphere of from 70 to 75 deg. fahr. dry bulb was different. The skin sensation was noticeable for the 10 per cent room and very noticeable for the ½ per cent room. While the outside relative humidities and air velocities have not been mentioned so far in this discussion, they

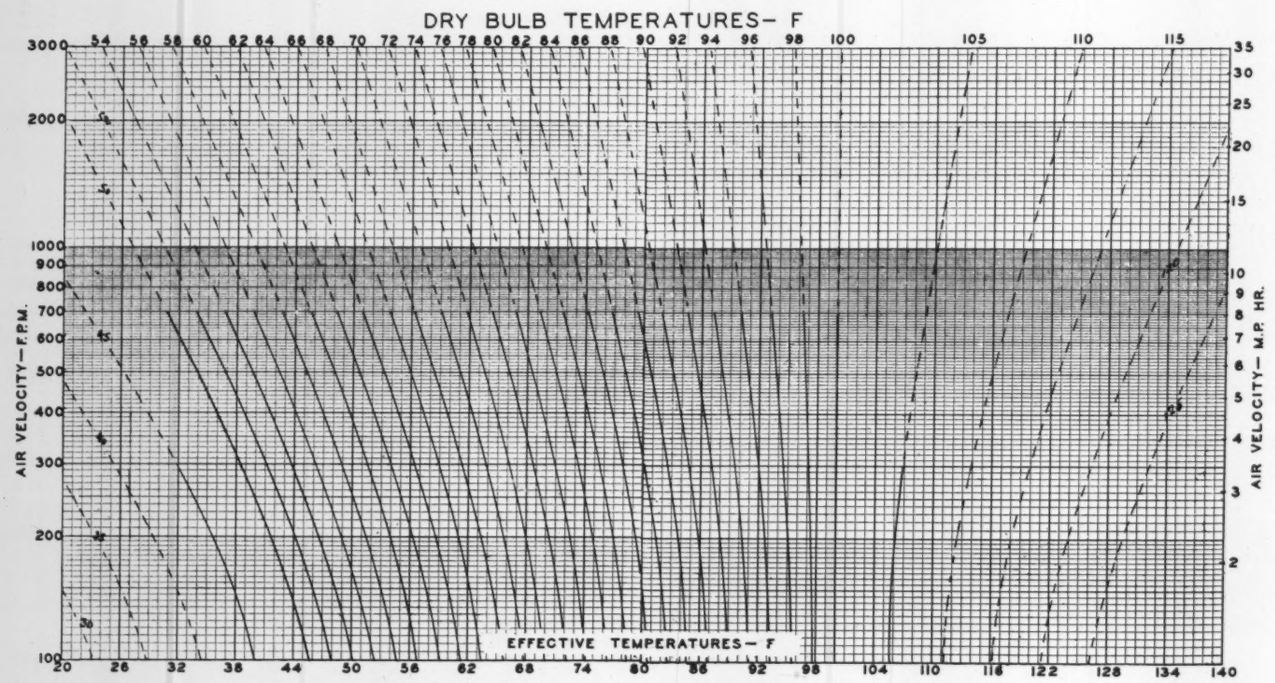



FIG. 1—EFFECTIVE TEMPERATURES FOR SUBJECTS NORMALLY CLOTHED AND SLIGHTLY ACTIVE AT 100 PER CENT RELATIVE HUMIDITY. NOTE: AT 100 PER CENT R. H. AND ZERO AIR VELOCITY, THE EFFECTIVE TEMPERATURE AND THE DRY BULB TEMPERATURE ARE IDENTICAL. EFFECTIVE TEMPERATURES READ FROM THE BOTTOM OF THE CHART UPWARD VERTICALLY, DRY BULB TEMPERATURES ARE READ DOWNWARD FROM THE TOP OF THE CHART ON THE LINES WHICH CURVE SLIGHTLY. AIR MOTION MAY BE READ ON THE HORIZONTAL LINES IN FEET PER MINUTE AT THE LEFT INDEX OR IN MILES PER HOUR AT THE RIGHT INDEX

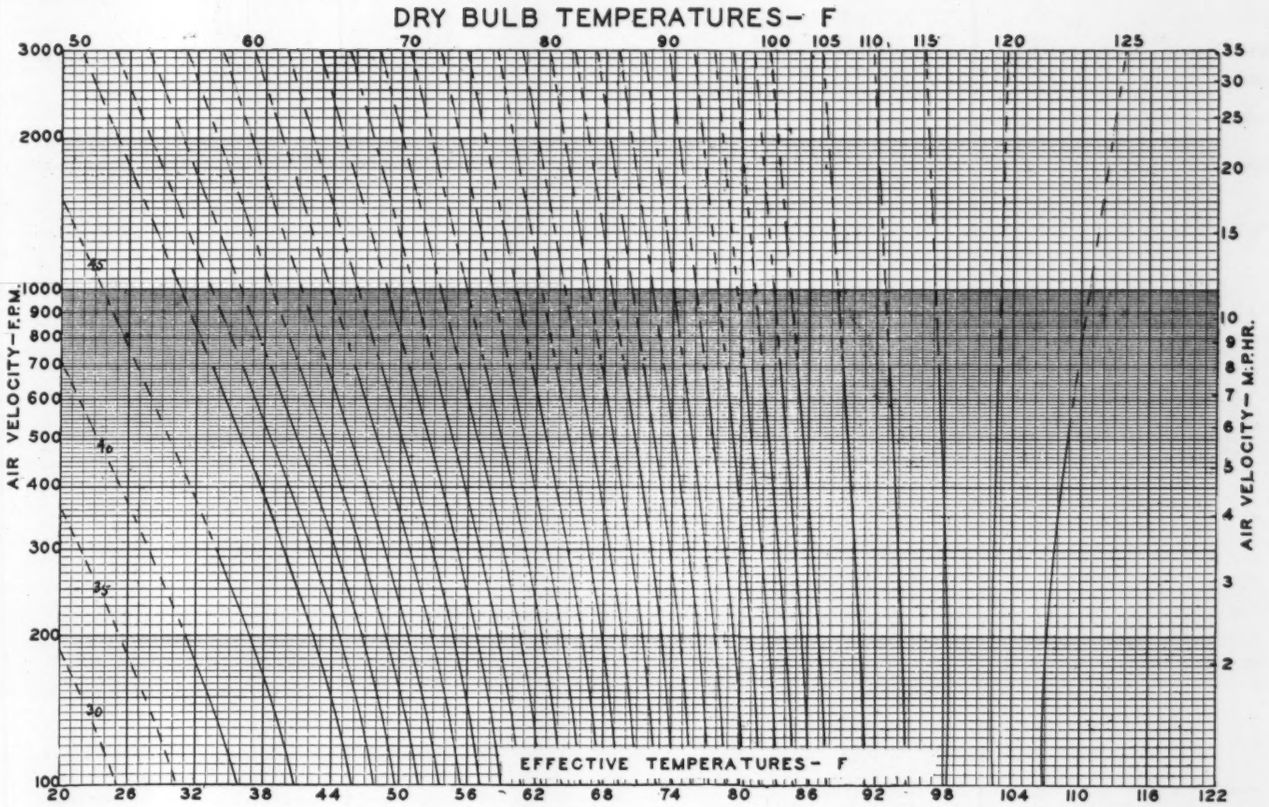



FIG. 2—EFFECTIVE TEMPERATURES FOR SUBJECTS NORMALLY CLOTHED AND SLIGHTLY ACTIVE AT 50 PER CENT RELATIVE HUMIDITY. EFFECTIVE TEMPERATURES READ FROM THE BOTTOM OF THE CHART UPWARD VERTICALLY, DRY BULB TEMPERATURES ARE READ DOWNWARD FROM THE TOP OF THE CHART ON THE LINES WHICH CURVE SLIGHTLY. AIR MOTION MAY BE READ ON THE HORIZONTAL LINES IN FEET PER MINUTE AT THE LEFT INDEX OR IN MILES PER HOUR AT THE RIGHT INDEX

naturally play a part, as we well know, in the feeling of comfort or discomfort experienced.

In order to investigate this problem, certain arbitrary limits must be set for outside and inside conditions. Without attempting a justification the following limits have been arbitrarily selected:

| | Inside (Air conditioned) | Outside (No conditioning) |
|---|---|---|
| Dry bulb—deg. fahr. | 70 to 85 | –10 to 120 |
| % R. H. | 40 to 60 | 15 to 90 |
| F.p.m. | 100 to 300 | 100 to 3,080 (35 m./h.) |
| Eff. Temp.—deg. fahr. | 60 to 75 | Below zero to about 140 deg. fahr. |

At first glance it will be seen that the conditions named for the outside are very reasonable but greatly outside the range of past experimentation in the field of human comfort. It also is evident that, in order to arrive at some method of balancing outside-inside conditions, it is necessary to at least approximate these limits. In order to obtain any conclusions it is, therefore, essential that interpolations be used with the available data. Such estimating can only result in approximations but, if the approximations obtained are better than previous information, they are justified until such a time as accurate data become available. Air conditioning engineers also will note the absence of wet bulb data in the above tabulations.

All air conditioning work in the past has been based on the wet bulb since it is so vitally concerned with latent heat. Today, the art is practiced not only by engineers but others who have no inhibitions regarding the wet bulb. Furthermore, it is easier to talk relative humidity than wet bulb to the general public. Finally, now that it definitely is known that the effective temperature and not the wet bulb is the index of human comfort, the factors of effective temperature, which are relative humidity, dry bulb temperature and air motion, have assumed a value previously unknown. It, therefore, seems best to use the factor relative humidity rather than wet bulb.

Effective temperature has been defined in a previous article on the value of human comfort in HEATING, PIPING AND AIR CONDITIONING.

The compilation of comfort data has only begun. As knowledge of comfort grows, and as practical applications increase, the charts and graphs of this art will improve. Therefore, any new method of plotting comfort data is likely to not only be interesting but also to lead to a better concept of human comfort.

For human beings normally clad, healthy and slightly active, the comfort data tabulated on page 96 of the 1925 *Transactions* of the A. S. H. V. E. will be found to apply. The reasons persons who have nose, throat and lung diseases do not have the same sense of comfort felt by normal people will be found in an article on "Air Conditioning for Diseases" in HEATING, PIPING AND AIR CONDITIONING, February, 1930.

In order to obtain approximate data as to the effect of air velocities greater than 700 f.p.m. on human

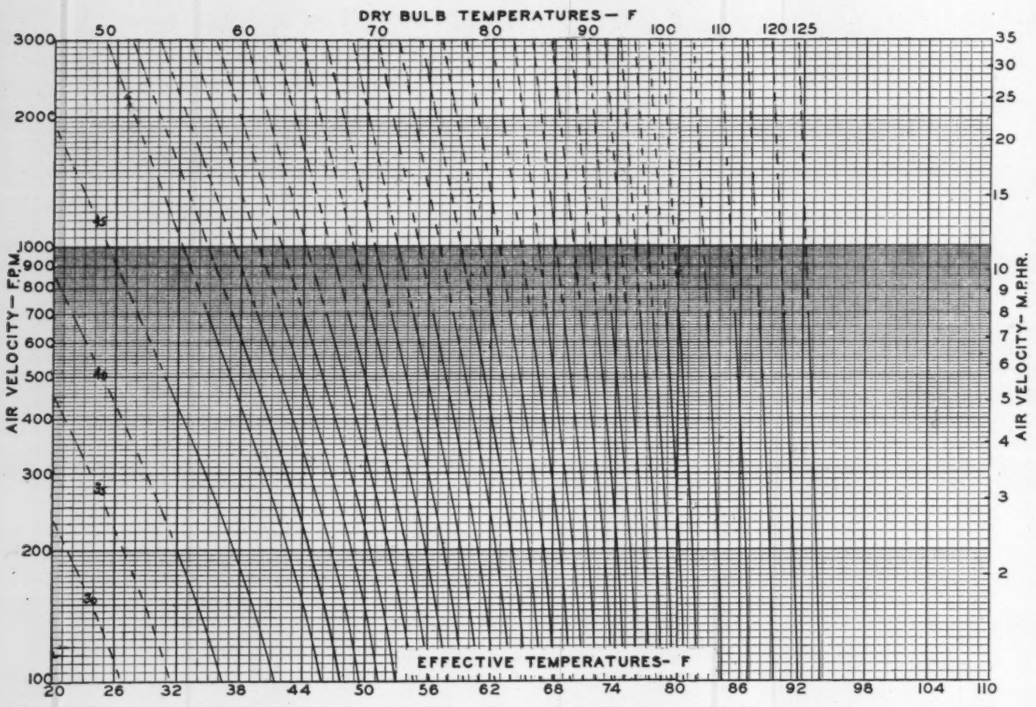



FIG. 3—EFFECTIVE TEMPERATURES FOR SUBJECTS NORMALLY CLOTHED AND SLIGHTLY ACTIVE AT 20 PER CENT RELATIVE HUMIDITY. EFFECTIVE TEMPERATURES READ FROM THE BOTTOM OF THE CHART UPWARD VERTICALLY. DRY BULB TEMPERATURES ARE READ DOWNWARD FROM THE TOP OF THE CHART ON THE LINES WHICH CURVE SLIGHTLY. AIR MOTION MAY BE READ ON THE HORIZONTAL LINES IN FEET PER MINUTE AT THE LEFT INDEX OR IN MILES PER HOUR AT THE RIGHT INDEX

comfort and to obtain a family of curves whose relations to each other are not distorted, the semilog form of chart must be used. The comfort data mentioned in the previous paragraph has been plotted on this type of chart and will be found in Figs. 1 to 3. The effective temperatures fall on straight, or vertical lines.

Thus the dry bulb lines become curves. Beyond the 700 f.p.m. air velocity line the dry bulb lines are continued as approximations in the form of dotted lines. This also is true of some dry bulb lines below the 700 f.p.m. line where the A. S. H. V. E. data are incomplete. As a result the charts presented give comfort data which will be useful in solving the condition of balance which is the subject of this article. It will be noted that the three charts mentioned do not extend below 100 f.p.m. Effective temperatures for air velocities between zero and 100 f.p.m. can, nevertheless, be easily estimated.

To demonstrate the value of these three charts, assume an outside temperature of 50 deg. fahr., a relative humidity of 20 per cent and a wind of 25 miles per hour. For the equivalent human comfort, what will the dry bulb temperature be inside a building, surrounded by the above atmospheric conditions outside, when the relative humidity is maintained at 60 per cent with 400 feet per minute air motion? Examination of Fig. 3 will give an effective temperature, outside, of 27 deg. fahr. With this same effective temperature the dry bulb temperature inside the building is found to be 42 deg. fahr. from Figs. 1 and 2. This is, of course, an uncomfortable atmosphere which can be improved slightly by raising the humidity or by increasing the air motion. Further examination of Figs. 1 and 2 will show that, for the same inside conditions noted above, a dry bulb temperature of 65 deg. fahr. would mean an effective temperature of 55 deg. fahr. This means that the inside dry bulb temperature must be increased 23 degrees in order to secure a 28 deg. fahr. rise in the effective temperature.

Editorial Note: A second article on "Balancing Outside-Inside Conditions" will appear in an early issue.

## Vacuum Drying with Electricity

One manufacturer has successfully dried telephone cable cores using electricity, and under atmospheric pressures. It can be demonstrated that heat introduced internally in the core will drive out the moisture at a much more rapid rate than where heat is applied externally. With vacuum driers and absolute pressures of about ¼ lb. per sq. in. the time interval for vacuum drying should not exceed 2 hours. It is probable that such drying methods may be accomplished by a continuous process, in the near future, where the vacuum drier will be quite small but longer. This seems more feasible now that cable cores are being manufactured in the 101-pair size and then twisted together on stranders to form larger sizes.—*M. T.*

According to the Bulletin of the *National District Heating Association,* there are 161 district heating plants in the United States supplying 239,929,194 square feet of radiating surface. The length of distributing mains is 4,332,745 feet, according to this source.

These plants serve 79,212 customers, and represent a capital investment of $237,150,000.

# Trap Installation and Operation

*By* T. H. Rea

IN PRACTICALLY all cases, it is desirable to install a steam trap below, and as near as possible to, the steam-heated unit drained by the trap. This gives gravity drainage to the trap for condensate, which increases the capacity of the trap by adding the static head of the condensate to the pressure of the steam. Furthermore, installing the trap close to the unit reduces radiaton losses between the machine and the trap. Before a slug of condensate can get to a trap through a long line, the steam already in the line must be condensed. This is of considerable importance in batch process and emergency installations where immediate elimination of condensate is necessary for either temperature control or protection of equipment. If, for any reason, long lines are necessary between the trap and the unit, steam binding can be prevented by venting the line as shown in Fig. 15. A slug of water coming down the line shown solid will force the steam in the line back to the unit through the vent line. Lagging the line between the trap and the separator or process equipment will cut down the heat loss, but at the same time will aggravate steam binding and make a vent line imperative.

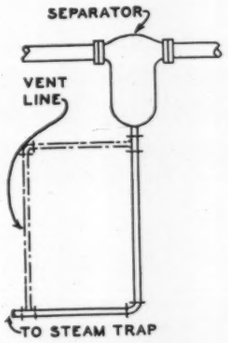



FIG. 15—STEAM BINDING CAN BE PREVENTED BY VENTING THE LINE AS SHOWN

Although gravity drainage to a trap is desirable it is not imperative. Installations as shown in Fig. 16 are not at all uncommon. The trap is continually radiating heat and hence condensing steam. The flow of steam carries water along the bottom pipe and up the vertical pipe to the trap. Water will not collect in the bottom pipe unless it is very large. However, if the trap becomes filled with air, no steam can condense and the unit will become filled with water.

If it is necessary to install a trap above a heating unit, a water seal at the low point is advisable as well as a check valve to prevent water from flowing back and to prevent loss of prime in case there should be a sudden pressure drop in the unit. An installation of this kind really amounts to a siphon-drained unit. The line between the trap and the unit should be small enough so the steam flow to the trap will carry all the water along and not allow water to flow back counter-current to the steam.

### Accessibility

Whenever possible, traps should be installed in accessible locations to facilitate inspection and repair. The trap in the "out of the way place" or "hard to get at" place is the trap that is usually neglected and allowed to get in bad condition.

The subject of trap accessibility raises the question of valve accessibility. One customer will insist on a trap so constructed that the valves and seats can be changed in a very short time. Another will insist on a trap that must be taken apart before valves and seats can be changed. Traps should be bought with valves and seats that do not need frequent changing—in other words, the life of the valve parts and not accessibility should be the determining factor. If immediate changing of valve parts is necessary, standard bypasses and spare traps are as desirable as any other method.

### Bypasses

There is considerable debate in steam trap circles concerning bypasses. Where continuity of service is of prime importance as, for instance, in emergency service, a bypass is a necessity. If anything happens to the trap, the bypass valves can be opened and the system will continue to drain even though there may be a temporary steam loss. Furthermore, if a plant establishes standard bypasses, trap examination and trap repair are greatly simplified, as one trap can be taken out and another installed in a very short time. The trap removed can then be taken to the machine shop for inspection and repairs.

Another advantage of bypasses is that they permit blowing down the machine or unit and thus eliminate all air quickly, consequently reducing warming-up time. This is of distinct advantage in some batch processes where instant heating is almost imperative. While this is one of the strong arguments in favor of bypasses, it is at the same time their greatest weakness. Process unit operators get the idea that if a little bypass is good, more would be better. Consequently they will leave the bypasses open all the time with attendant waste of steam. Even though the operator appreciates the necessity of shutting off the bypass and plans to do so, his attention is frequently diverted and a big steam loss ensues. While bypasses are open, intentionally or otherwise, steam pressure will build up in the return line, frequently interfering with trap operation in other parts of the system. Bypass valves may develop steam leaks which run into many dollars before they are discovered.

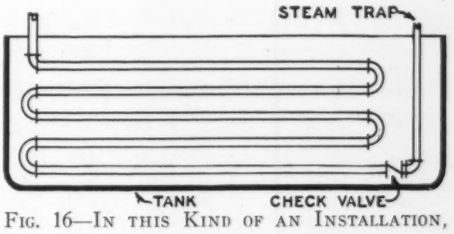



FIG. 16—IN THIS KIND OF AN INSTALLATION, THE FLOW OF STEAM CARRIES WATER ALONG THE BOTTOM PIPE AND UP THE VERTICAL PIPE TO THE TRAP

We may safely conclude that bypasses can be used to advantage in many trap installations. However, bypasses require watching, both to insure that they are

This is the fourth of a series of five articles on steam traps.

not left open with a great steam loss and to prevent serious leaks from developing in the valves themselves.

### Test Cocks

Except in the case of the small thermostatic traps used on radiation in residences, hotels, offices and the like, a test cock or other means for observing the discharge is desirable. A three-way test cock in the discharge line is about as simple an installation as can be made. In one position, the discharge line is open, in the second position the discharge line is closed and in the third position, the discharge line remains closed but the trap can discharge to the atmosphere. Be sure to note that when a three-way test cock is used, the discharge line is closed before the trap discharge can be observed. If merely a valve in the discharge line were opened to the atmosphere without closing the line itself, the observed discharge might or might not be the trap discharge. If there were any amount of back pressure in the system and the trap in question were perfectly tight, the return line steam blowing through the test valve would make it appear as though the trap were leaking. Hence, before a test cock trial can be of value, the trap should be shut off from the return lines.

It seems hardly necessary to point out the advantages of test cocks and a periodic check on trap operation. Of course, flash steam in the discharge must not be confused with live steam blowing through the trap. An experienced trap maintenance man can tell almost instantly by observing the discharge whether a trap is working all right or blowing steam. If the trap discharge is satisfactory, nothing need be done other than a periodic examination of the trap to check its mechanical condition. Valves and seats should be ground in or replaced in leaky traps and, if the trap has been blowing through badly, the entire mechanism should be checked and put in first class condition.

Very often it is almost impossible to tell by watching the discharge whether or not a trap is leaking live steam. When in doubt, the valve parts should be changed or ground. If, for any reason, the trap can not be taken off the line for changing valve parts or inspection, a steam test will prove whether or not the trap is losing live steam. To make a steam test proceed as follows:

### Testing Traps

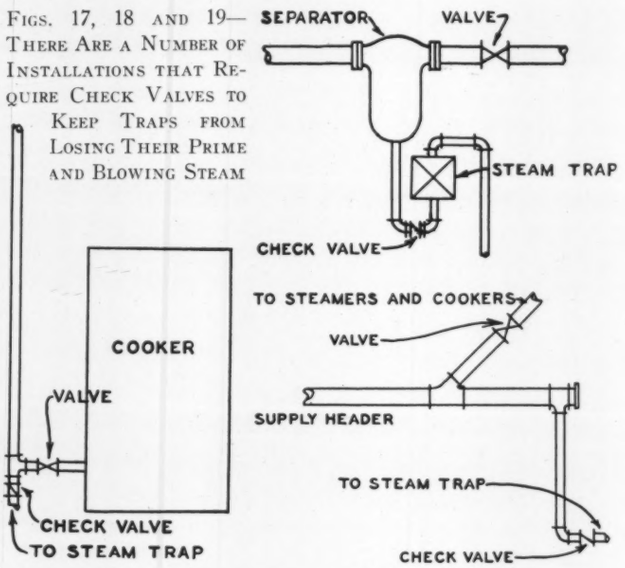
A length of pipe should be run from the trap discharge to a point underneath the water level in a bucket half full of cold water. The line must end below the water level so no flash or live steam can escape. Before starting the test, the weight and temperature of the water in the bucket should be taken and recorded. The trap is allowed to discharge into the water until the temperature of the water in the bucket is as much above room temperature as the original temperature was below room temperature. Temperature and weight of the water in the bucket should again be recorded. After this information has been recorded, proceed as in the following example to calculate whether or not there has been any steam lost.

| | | |
|---|---|---|
| Weight of cold water at start | 15 | lbs. |
| Temperature at end of test | 90 | F |
| Temperature at start of test | 50 | F |
| Increase in temperature | 40 | F |
| Heat added to water 15x40 | 600 | B.tu |
| Steam pressure at trap (gage) | 60.3 | lbs. |
| Heat in 1 pound of discharged water at steam temperature (from steam table) | 277.4 | B.tu |
| Heat in 1 pound of discharged water at end of test; 90-32 equals | 58 | B.tu |
| Heat given up by 1 pound of discharged water | 219.4 | |
| Weight of discharged water to bring in 600 B.tu. 600 ÷ 219.4 | 2.75 | lbs. |
| Weight of water discharged | 2.8 | |

Since the weight of discharged water is greater than would be required to account for temperature rise, the trap does not leak steam. If the weight of discharged water is less than calculated, it indicates that the latent heat in live steam blowing through is making up the extra heat not accounted for by water alone.

### Condensation of Steam in Traps

Engineers sometimes refer to some types of traps consuming or condensing more steam than others. Provided valves are tight, the type of trap makes little, if any, difference. No more steam can be condensed by a trap than the heat loss from the trap.




FIGS. 17, 18 AND 19—THERE ARE A NUMBER OF INSTALLATIONS THAT REQUIRE CHECK VALVES TO KEEP TRAPS FROM LOSING THEIR PRIME AND BLOWING STEAM

### Use of Check Valves

There are a number of trap installations that require check valves to keep traps from losing their prime and blowing steam. If there is a sudden pressure drop in the line leading to the trap, a part of the water in the trap will flash into steam and very likely carry a large part of the water from the trap back into the line past the inlet line to the trap. Then when the pressure stops dropping or when it starts to build up, there is not enough water to float the bucket and the valve remains open and the trap blows steam. Since the lines to the trap are already hot, the amount of condensate coming to the trap may be very small and this small amount of condensate will blow on out with the steam. Figs. 17 to 19 show typical installations of this sort.

### Dirt in Traps

Some types of traps have greater capacity than others for handling dirt and sludge, but no matter how much

dirt a trap can handle, the discharge orifice definitely limits the size of dirt particles that can be discharged. The majority of trap installations do not require strainers, but in many cases the dirt and scale conditions are so bad that strainers or dirt pockets are imperative. These to be effective must be cleaned periodically. A very effective dirt pocket can be made from ordinary pipe fittings as shown in Fig. 20. A pipe cap will do to close the bottom end of the dirt trap, but a suitable blow-down valve is much more convenient. Frequently, dirt trouble will be encountered soon after the trap is installed. Scale and pipe cuttings are usually left in the lines when the installation is made, and once the dirt is cleaned out of the trap no more trouble is experienced.

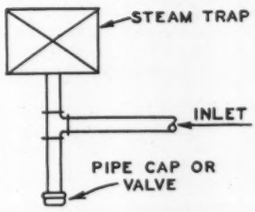



FIG. 20 — AN EFFECTIVE DIRT POCKET MADE FROM PIPE FITTINGS

The fifth and last of Mr. Rea's series on steam traps will be published in an early issue.

## Welded Pressure Vessels

### Design of Shell

Shell thickness is determined by the allowable design fiber stress in accordance with the usual formula:

$$t = \frac{PD}{2S}, \text{ where}$$

$t$—thickness of shell in inches; $P$—working pressure in lb. per sq. in.; $D$—internal diameter of shell in inches; $S$—design fiber stress in lb. per sq. in.

At the beginning of the investigations on welded pressure vessels, a conservative design fiber stress of 7,000 lb. per sq. in. was purposely used.

As test data accumulated, it become evident that a higher fiber stress could be employed safely and for some time a design fiber stress of 9,000 lb. per sq. in. has been used for unfired vessels.

This figure still gives a factor of safety of over 5 based on ultimate strength, since welders are required to submit qualification tests of 50,000 lb. per sq. in. for acceptance.

In locating shell seams, it is well to remember that longitudinal seams can be welded more readily than girth seams. Where the size of the vessel permits, it is desirable to construct the shell in one course using only longitudinal welds. Where girth seams are necessary, the longitudinal welds should be staggered at each girth seam as follows:

One seam per course.....180 deg.
Two seams per course..... 90 deg.
Three seams per course..... 60 deg.

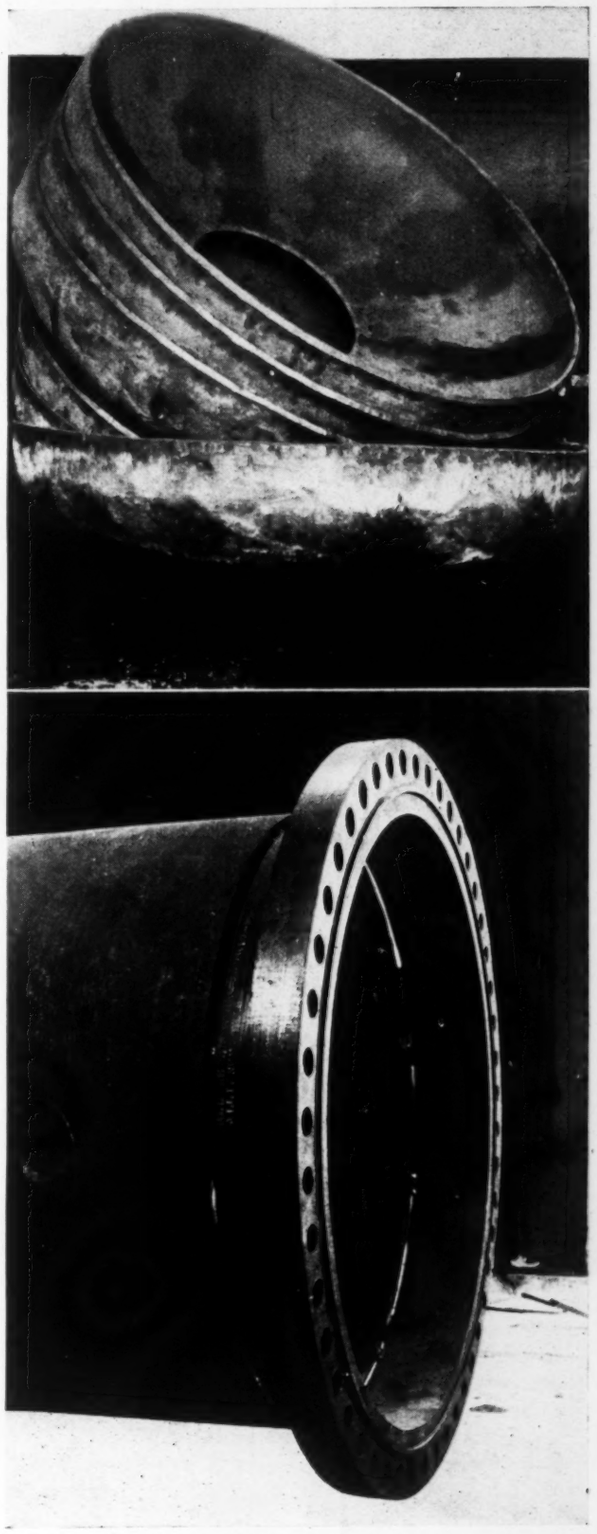
Longitudinal seams in every case should meet the girth seams as tees and not as crosses.

### Head Design

Strain gage measurements referred to above showed that when the standard dished head (having a crown dish equal to the diameter of the shell and a small knuckle radius) is subjected to internal pressure, serious stresses are shown to develop at the knuckle.

These stresses at the knuckle are entirely out of proportion to those in the shell and are of sufficient magnitude to give considerable concern even where design is based on a factor of safety of 5 or more.

Investigation showed that the correct design for eliminating high local stress is an ellipsoid with a ratio of two to one between major and minor axes.



ABOVE—ELLIPSOIDAL HEADS. BELOW—COLUMN FLANGE TACKED READY FOR WELDING

# "Open for Discussion"

**A department in which we follow the custom of technical societies of allotting space in their programs for discussion of the papers presented**

## VENTILATING SCHOOLS

**"School Building Ventilation," *by Samuel R. Lewis.* Page 494, issue of October, 1929**

I HAVE just read the interesting article by Mr. S. R. Lewis, in the October HEATING, PIPING AND AIR CONDITIONING.

While I wish to emphasize the fact that I am not an authority, I beg leave to differ with Mr. Lewis on his statement that the importance of schoolroom ventilation is greatly overstressed because of the relatively small part of the time the child actually spends in the schoolroom.

I feel that controlled schoolroom ventilation is of greater importance than is generally conceded, regardless of any results obtained by investigations, the very nature of which preclude the possibility of definite conclusions. We are, therefore, compelled mainly, to resort to common sense deductions rather than to established facts until such time as more reliable tests are devised and carried out.

It is, of course, true that a child spends a relatively small part of his time in the schoolroom, "¼ of 5/7 of 9/12" of his early life, as you state. But that time so spent represents the greatest number of waking hours that a normal child spends in an artificially heated environment. The time spent in the classroom represents, however, not only the major portion of the time spent indoors, but also the period which he is called upon to make his greatest mental effort and during which time he is subjected to the maximum danger of infections, especially of a respiratory nature. In view of this, it would seem that the time little Johnny spends in the schoolroom environs bears a much more "vital effect on his general life" than the mere fraction "¼ of 5/7 of 9/12" suggests.

### Ignorance of Relation Between Air Conditioning and Physiological Requirements Important

Ignorance, Mr. Lewis states, both of operation and design is the cause of the somewhat widespread criticism of mechanical ventilation. This, I believe, is generally conceded to be true, but, it occurs to me that ignorance of the relation between air conditioning and the physiological requirements of the body may also play an important part in any failure of mechanical ventilation to produce better results, especially as to the promotion of health.

We know that if we disturb the chemical or intercellular balance of the cells of the respiratory tract we break down (or weaken) our "first line of defense" against colds, "flu" and other infections of this nature. And yet the comfort chart permits, within the higher ranges of the comfort zone, such degrees of dryness as would unquestionably bring about this condition. Body comfort, it appears to me, should have been determined only after the loss of moisture consistent with the physiological welfare of the cellular structures of the body had been established. Also, body metabolism and its relation to heat, air motion, and humidity should be given further study. Possibly barometric pressure may be found to exert an influence upon the relation between body function and air conditioning, for, as we know, all gases, including oxygen, are absorbed in direct proportion to the atmospheric pressure.

The opportunity for medical research in this most interesting field seems unlimited, and, it is my opinion, that ideally conditioned air will be obtained only upon close co-operation between the medical and engineering professions.—*S. Munson Corbett, M. D.*

## A. S. H. V. E. Code of Minimum Requirements for Heating and Ventilation of Buildings

*By* Samuel R. Lewis

**"The Code of Minimum Requirements," *published by the American Society of Heating and Ventilating Engineers.***

*GENERAL Requirements (Sec. I):*— Every little while, some friend in the legislature of my own state or of some adjoining one wants information about compulsory ventilation laws; how to draw them up; what to require, etc.

Any old timer in the *American Society of Heating and Ventilating Engineers* will remember that usually there was a committee on compulsory ventilation laws. Once in a while they caught some efficient man on this committee and he proposed a "code" which any law-making authority might adopt. He proposed this code and perhaps it was printed in the Transactions of the Society and then was lost and forgotten.

Now Mr. L. A. Harding and his committee have printed, in the 1929 Code of Minimum Requirements, a form of basic code which is straightforward and simple. If anyone does not like the synthetic air chart he can easily find in the Guide a table of approximate amounts of air to be provided per square foot of floor space, and can use them in lieu of the more elegant synthetic air chart.

How clumsy many human activities are, anyway! For years we go on dividing the square feet of floor space in a school room by 15 to determine the number of pupils and then multiply the quotient by 30 to learn how many cubic feet per minute of air shall be supplied. How much more satisfactory to say merely that there shall be delivered into each school room 2 cubic feet of air per minute per square foot of floor area in the room.

The code in question takes cognizance in paragraph 12 of the effect of windows.

It has become necessary in the development and enforcement of compulsory ventilation laws to recognize and to give credit for large amounts of window area. In some cases ventilation immunity is given in large rooms of certain classifications, as offices and churches, for all floor area up to ten times the effective window area; mechanical ventilation being required only for the floor area in excess of ten times the effective window area.

By effective window area I mean the area in windows one-half of which (or more) may be opened when desired. When such credits are to be computed the clumsiness of the "cubic feet per occupant" basis becomes evident.

Be it known if you ever need to look up a model compulsory ventilation ordinance, such a one may be seen spread as Section I of the *American Society of Heating and Ventilating Engineers'* Code of Minimum Requirements for Heating and Ventilation of Buildings.

**Because of numerous requests from engineers, architects, manufacturers, municipal building departments and various interested organizations, the American Society of Heating and Ventilating Engineers has established a Code of Minimum Requirements which is aimed to standardize, as far as possible, the installation of heating and ventilating equipment.**

**Samuel R. Lewis, consulting engineer, has commented on many of the features of this Code. His remarks, published in these columns, will be of value, we feel, to engineers wishing to apply the Code to heating and ventilating work. Other sections of the Code will be considered in later issues.**

**The Code is written so that it may be incorporated as a part of municipal building codes and is recommended by the Society for adoption as such without alterations or exceptions, in order that there may be the desirable condition of uniformity in these branches of engineering throughout the United States. The information contained in the Code represents the *minimum requirements* as called for by good practice at the present time.**

**According to a foreword published with the Code, it is expected to revise and enlarge it from time to time in order to keep pace with new data accumulated from research as new methods are developed and old are improved.**

*Minimum Requirements for estimating the heat required for warming buildings. (Sec. II)*:—There is only one accurate way to compute the heat loss from buildings. This is by having advance knowledge of the kind of material of which the building is built, and of how much heat this material customarily permits to pass.

The gist of Section II of the code is that it tells the conductivities of many kinds of material and shows how to compute from them the transmission coefficients of many wall and floor and ceiling combinations.

We are learning more every day about how to compute heat losses, especially as several competent universities now are carrying on research in this matter under our direction.

The man who computes the heat losses, however, always must know how to assume the proper temperatures from which to compute them. For instance, suppose we have a lofty room heated by direct steam conductors. The ceiling of that room is thin and leaky. There is an attic above the ceiling under a poor and chilly roof.

We may assume 70 degrees for the room temperature four feet above the floor, but we will fail to heat such a room unless we know enough to gauge pretty nearly correctly the temperature in the room directly under the leaky ceiling. If that temperature is, say 90 degrees, the attic above it, dry and warm, soon will approach 90 degrees and the heat loss will have to be computed then for the ultimate roof regardless of the attic.

This phenomenon has resulted in some erroneous conclusions as to the value of building insulation as follows:

If the ceiling used to be heated to 80 degrees to get the floor to 65 degrees, evidently much heat used to enter the attic. The attic then must have been warmer than the outdoor temperature, and the ceiling below the attic must have been cooler than it would have been had the attic not absorbed the heat.

Therefore, in computing the heat loss with an uninsulated ceiling we might find 70 degrees below the ceiling and 60 degrees above it, a difference of 10 degrees; while in computing the heat loss with an insulated ceiling we might find 80 degrees below the ceiling and 30 degrees above it, a difference of 50 degrees.

While these facts seem to discount the value of insulation, the increase in temperature difference with insulation does not by any means offset the decrease in conductivity per unit of area after adding the insulation.

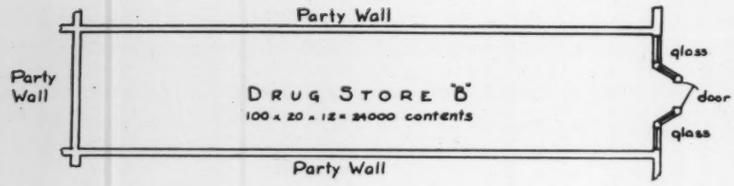
Section II discusses very thoroughly all of the matters of moment in estimating the heat required for warming buildings. The lore there is applicable equally well for any kind of heating. It covers infiltration or leakage of air, and the effect of wind on increasing heat exchange.

It was necessary, in order to be conventional, to include Table 6, a list of guessed-at air changes. This is an example of the inconsistency of man for, after figuring accurately the transmission of the wall, we guess at the infiltration.

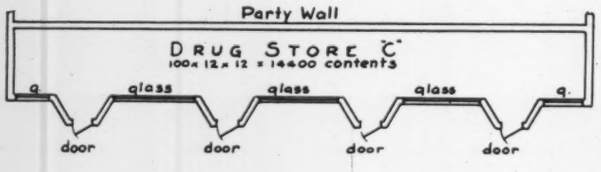
One is struck by the same sort of thing throughout all engineering literature. Unit heat transmissions or unit tensile stresses are most painstakingly developed and are combined with assumed factors which can not similarly be computed, but which may vary many fold the gnats-heel factors. We figure strength down to ounces and then add a safety factor of perhaps five hundred per cent.

It seems to me that infiltration or "air changes" has a very small community of interest with heat loss. The air change or leakage is a function of how much window and wall is exposed to the out-of-doors.

It seems to me that the engineer who computes separately the heat losses of the wall and glass which are




24000 x 2 = 48000 cu. ft. per hour infiltration. A fairer figure would be 10000 cu. ft. per hour in view of the small opportunity for loss. This store always would too warm figured by conventional methods.




14400 x 3 = 43200 cu. ft. per hour infiltration. If based on the same rate per exposed area as in the other store, this one of smaller cubage would have an allowance for infiltration of 50000 cu. ft. per hour.

If figured by table 6, even allowing for three air changes per hour, this peculiar store would be chilly.

exposed to the wind, and of the ceiling or floor if these are exposed, and who then adds some percentage of these losses as an infiltration factor, is an intelligent engineer.

Suppose we have, referring to Table 6 of the Code, which says that a drug store needs two to three air changes per hour, two drug stores as per sketches B and C. One deduces that for B, with its small glass and door area, two changes per hour are needed, while for C, with its enormous glass and door area, three changes per hour are required. Wouldn't it be much wiser to add to the exposed wall and glass areas of each store a percentage of each? A percentage of about thirty proves to be a fair average.

*Sec. III*:—Section III of the code gives the amount of heat which can be expected from various kinds of steam and hot water radiators and makes record of some of the influences of various enclosures on the heat emission.

Pending the adoption of some sort of rational testing code for all sorts of radiators, it is not to be wondered at that Section III is very short.

I cannot at the moment think of any phase of heating engineering which is in a worse tangle today than that of steam and hot water conductors and convectors.

There is no agreement as to nomenclature. A radiator may be anything. Some of us are trying to start the ball rolling by differentiation to the extent that any enclosed "radiator" shall be called a convector, and any exposed "radiator" shall be called a conductor.

So clumsy are the trade terms and so ponderous is the human mind that although it is agreed universally that a square foot of direct steam radiation (a square foot of a conductor) is the equivalent to 240 heat units, and although no radiator or convector or conductor today is rated or sold on actual square feet of hot surface, and although the heat requirements of buildings are calculated universally in heat units, still we must mark "square feet" on the drawings and must go through the meaningless form of "square feet" in thinking of boilers and pipe sizes.

It is well known that all non-ferrous extended surface convector heaters such as are now so popular as concealed radiators actually have a small fraction of the square feet of surface which would be indicated if their output were divided by 240 heat units. It is well known that the output per unit of surface in such heaters is changed materially as the height of the flue in which the heaters are placed varies.

This confirms a truth well known to engineers that the old column type cast iron conductor or direct radiator has a very variable output, depending on its height, on its location in the room and on what sort of surfaces and on how much free air circulation there is between the surfaces which are "seen" by the radiating surface.

It seems desirable that we shall compute the heat losses of the room and that we shall mark the plans with the heat requirement directly, not bothering as at present first to divide by 240 and then to use some conversion factor so as to mark the radiator "Brass copper-fin No. 220." Why not mark the plan "Required 10460 B.tu; Radiator, 2 Brass copper-fin, each 5230 B.tu?"

Then the boiler, instead of being rated at, say 20,000 sq. ft. discounted fifty per cent by the master fitters' rules and arrived at by an involved process of calculation after consulting the brass copper-fin catalog and reducing the convectors to equivalent square feet as at present, would be selected directly on a heat unit basis. To select the boiler the engineer merely totals the heat losses of the building, cutting through the item of radiation entirely, since after all it is the *building* we wish to heat, not the radiators. It will be much easier to select the proper boiler for each type of building use when this Utopian day arrives, and there will be fewer errors.

Frequently in this day the radiation may be less effective than was hoped, and is too small, and the boiler selected to fit the radiation then is too small, because each unit of the radiation being in cooler rooms, does more work than it would do in normal rooms.

These remarks apply equally well to all pipe size tables which are based on a 240 heat unit basis per "square foot" while such a basis no longer exists.

All pipe size tables should be based on heat units directly, in the interest of the conservation of natural resources.

Speaking of conductors and convectors and of a testing code, research is being carried on in several laboratories. People in a position to know a good deal about it suggest that radiators should be selected on the basis of the knee high temperature they will maintain in a given proper or favorable room, rather than, as at present, on the amount of steam which they will condense when the room in which they are placed is at 70 degrees.

It is hoped that Section III will be brought up-to-date very soon.—*Samuel R. Lewis.*

# Some Fundamentals of Hydraulic Piping

*By* Frederick G. Schranz

HIGH pressure water for use in hydraulic presses was first applied by Bramah in 1795. The hydraulic accumulator was first invented by Lord Armstrong in 1850. Since then hydraulic piping to convey high pressure water from the pump to the accumulator and from there to the final application in the operation of hydraulic machinery came into use.

High pressure water is created by means of pumps or through intensification. Generally, pressures up to 3000 lb. per sq. in. and sometimes up to 6000 lb. are used in conjunction with the accumulator system, thus requiring long high pressure pipe lines. Pressures up to 20,000 lb. per sq. in. and higher are obtained by means of an intensifier. In this intensifier, low pressure water, steam or compressed air applied to the low pressure cylinder will be converted into high pressure, which is discharged from the high pressure intensifier cylinder in a limited quantity.

To store high pressure water in large quantities, an hydraulic accumulator is employed, consisting of a long stroke cylinder and ram. The suspended ballast gives the required hydraulic pressure. These weighted accumulators can be either of the moving ram or moving cylinder type.

The ballast weight can be in the form of solid weights made from cast iron or cast concrete, or loose material such as iron ore, scrap iron, sand or water when contained in a ballast tank.

*Joseph Bramah was born on April 13th, 1748, in Stainborough, Yorkshire, England.*

*His father was a farmer, but Bramah, on account of an accident to his ankle, was unable to work on his father's farm. After his school years he became a cabinet maker apprentice and worked at this trade in London, later having a shop of his own.*

*In 1795 he invented the hydraulic press.*

*He demonstrated his invention by filling a closed vessel completely with water. The top of the vessel had one large and one small opening through which he fitted two plungers tightly and provided a special collar which secured water tightness between plungers and vessel. By loading the small plunger with a weight he found that the larger plunger would lift a much heavier weight. For the collar forming the packing between plunger and vessel he was indebted to one of his workmen, Henry Maudslay.*

*Bramah died December 9th, 1814.*

## Working Pressures for Pipe

The table below gives three types of pipe (standard, extra strong and double extra strong) and working pressures for each size pipe. For extremely high pressures, seamless drawn tubing or drilled steel bars are used.

Pipe fittings and flanges for low pressures and smaller sizes are of cast iron or malleable iron with screwed ends, while for higher pressures, cast steel or forged steel fittings and flanges are used. Pipe joints between pipe and fittings on low pressure lines and smaller sizes are made with taper pipe thread, while for high pressures and larger sizes, only flanged joints with recessed gaskets should be used (see A. S. M. E. Standard).

## Laying New Pipe Line

Precaution must be taken when laying a new pipe line that all pipes are clean inside and free from scale. Considerable grief and trouble is caused if sand or inside pipe scale, when turning on high pressure for the first time, gets into the hydraulic cylinders or hydraulic operating valves, as it will cut the rams and plungers and destroy valve packing and valve seats. All pipe before laying should be hammered on the outside to loosen all scale

| SIZE Inches | Outside Diameter Inches | Diameter at Top of Thread Inches | Diameter at Bottom of Thread Inches | Number of Threads | STANDARD PIPE | | | | | | EXTRA STRONG PIPE | | | | | | DOUBLE EXTRA STRONG PIPE | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Weight per Foot | Inside Diameter Inches | Thickness Inches | Working Pressure Factor 6 | Bursting Pressure | Area in Sq. Inches | Weight per Foot | Inside Diameter Inches | Thickness Inches | Working Pressure Factor 6 | Bursting Pressure | Area in Sq. Inches | Weight per Foot | Inside Diameter Inches | Thickness Inches | Working Pressure Factor 6 | Bursting Pressure | Area in Sq. Inches |
| ⅛ | .405 | .393 | .334 | 27 | 0.24 | .27 | .068 | | | .06 | .31 | .215 | .095 | | | | | | | | | |
| ¼ | .54 | .522 | .433 | 18 | 0.42 | .36 | .088 | 2172 | 13,032 | .10 | .53 | .302 | .119 | 2,937 | 17,624 | | | | | | | |
| ⅜ | .675 | .658 | .568 | 18 | 0.56 | .49 | .091 | 1797 | 10,784 | .19 | .73 | .423 | .126 | 2,488 | 14,928 | | | | | | | |
| ½ | .84 | .815 | .701 | 14 | 0.84 | .62 | .109 | 1731 | 10,384 | .30 | 1.08 | .546 | .147 | 2,333 | 14,000 | .231 | 1.714 | .252 | .294 | 4666 | 28,000 | .047 |
| ¾ | 1.05 | 1.025 | .911 | 14 | 1.12 | .82 | .113 | 1434 | 8,608 | .53 | 1.47 | .742 | .154 | 1,954 | 11,728 | .425 | 2.440 | .434 | .308 | 3910 | 23,464 | .140 |
| 1 | 1.315 | 1.283 | 1.144 | 11½ | 1.67 | 1.04 | .133 | 1348 | 8,088 | .86 | 2.17 | .957 | .179 | 1,814 | 10,888 | .710 | 3.659 | .599 | .358 | 3629 | 21,776 | .271 |
| 1¼ | 1.66 | 1.627 | 1.488 | 11½ | 2.24 | 1.38 | .140 | 1124 | 6,744 | 1.49 | 2.99 | 1.278 | .191 | 1,533 | 9,200 | 1.271 | 5.214 | .896 | .382 | 3068 | 18,408 | .615 |
| 1½ | 1.9 | 1.866 | 1.727 | 11½ | 2.68 | 1.61 | .145 | 1017 | 6,104 | 2.03 | 3.63 | 1.500 | .200 | 1,403 | 8,416 | 1.753 | 6.408 | 1.100 | .400 | 2807 | 16,840 | .930 |
| 2 | 2.375 | 2.339 | 2.223 | 11½ | 3.61 | 2.06 | .154 | 864 | 5,184 | 3.35 | 5.02 | 1.939 | .218 | 1,223 | 7,336 | 2.935 | 9.029 | 1.503 | .436 | 2560 | 15,360 | 1.744 |
| 2½ | 2.875 | 2.820 | 2.620 | 8 | 5.74 | 2.46 | .203 | 941 | 5,648 | 4.78 | 7.66 | 2.323 | .276 | 1,280 | 7,680 | 4.209 | 13.695 | 1.771 | .552 | 2447 | 14,680 | 2.419 |
| 3 | 3.5 | 3.441 | 3.241 | 8 | 7.54 | 3.06 | .216 | 823 | 4,936 | 7.38 | 10.25 | 2.900 | .300 | 1,142 | 6,856 | 6.569 | 18.583 | 2.300 | .600 | 2285 | 13,714 | 4.097 |
| 3½ | 4.0 | 3.938 | 3.738 | 8 | 9.00 | 3.56 | .226 | 935 | 5,610 | 9.83 | 12.50 | 3.364 | .318 | 1,325 | 7,950 | 8.856 | 22.850 | 2.728 | .636 | 2650 | 15,900 | 5.79 |
| 4 | 4.5 | 4.434 | 4.234 | 8 | 10.66 | 4.02 | .237 | 877 | 5,268 | 12.73 | 14.98 | 3.826 | .337 | 1,246 | 7,480 | 11.45 | 27.541 | 3.152 | .674 | 2495 | 14,970 | 7.724 |
| 4½ | 5. | 4.931 | 4.731 | 8 | 12.34 | 4.50 | .247 | 823 | 4,940 | 15.93 | 17.61 | 4.290 | .355 | 1,183 | 7,100 | 14.39 | 32.530 | 3.580 | .710 | 2367 | 14,200 | 9.976 |
| 5 | 5.563 | 5.490 | 5.290 | 8 | 14.50 | 5.04 | .258 | 772 | 4,630 | 19.99 | 20.77 | 4.813 | .375 | 1,123 | 6,740 | 18.19 | 38.552 | 4.063 | .750 | 2247 | 13,480 | 12.96 |
| 6 | 6.625 | 6.546 | 6.346 | 8 | 18.76 | 6.06 | .280 | 703 | 4,220 | 28.88 | 28.57 | 5.761 | .432 | 1,091 | 6,550 | 25.98 | 53.160 | 4.897 | .864 | 2173 | 13,040 | 18.67 |
| 7 | 7.625 | 7.540 | 7.340 | 8 | 23.27 | 7.02 | .301 | 657 | 3,940 | 38.73 | 38.04 | 6.625 | .500 | 1,086 | 6,520 | 34.47 | 63.079 | 5.875 | .875 | 1912 | 11,470 | 27.11 |
| 8 | 8.625 | 8.534 | 8.334 | 8 | 28.18 | 7.98 | .322 | 622 | 3,730 | 50.03 | 43.38 | 7.625 | .500 | 963 | 5,780 | 45.66 | 72.424 | 6.875 | .875 | 1690 | 10,140 | 37.12 |

and care should be exercised so as not to pick up any sand or dirt in the pipe while installing.

### Dangers of Air in High Pressure Lines

One of the most important precautions to be taken with high pressure systems is to eliminate all air and air pockets. Air, when compressed in a high pressure line or hydraulic cylinder with high pressure water behind it, will cause tremendous shocks in the pipe line, thus bursting fittings, hydraulic cylinders or splitting the pipe. When this highly compressed air, through such breakage, is suddenly released, due to its stored energy, it will throw such broken parts with considerable force and to a great distance. Water alone, under high pressures, is reduced in volume only a very small amount, and when suddenly released, will drop in pressure immediately, doing no damage.

To prevent air pockets in high pressure pipe lines, small high pressure air valves must be installed at all points where air can accumulate, generally on top of a pipe bend or on top on the inside of a hydraulic cylinder, and these air valves should be opened from time to time.

*Baron William George Armstrong was born on November 26, 1810, in New Castle on the Tyne.*

*He was the founder of the Elswick Manufacturing Company and a member of the firm Donkin, Stable and Armstrong in New Castle.*

*In 1839 he invented the improved rotary water motor. Soon thereafter he built an hydraulic crane and other hydraulic machinery for which he and Elswick became famous as builders of hydraulic machinery, and, later, as manufacturers of guns, especially heavy naval guns, for the manipulation of which he used hydraulic power.*

*In the year 1850 he required a large quantity of higher pressure water for an hydraulic installation for a ferry station. This led him to the invention of the hydraulic accumulator, which consisted of a large cylinder containing a piston that could be loaded to give the required hydraulic pressure.*

*Armstrong was raised to the peerage in 1887.*

*He died December 27, 1900.*

### Shocks in Pipe Lines

Due to the high velocity of high pressure water flowing through a pipe line, care must be taken to eliminate the tremendous shocks which will be caused by the sudden stoppage of this flow, caused, for instance, by closing the high pressure operating valve on the hydraulic machine or by the sudden stoppage of the descending accumulator. A hydraulic shock valve should be installed. The location of this shock valve should be near to the hydraulic machine, while other shock valves must be located on the dead end of each pipe line and one shock valve near the accumulator outlet. This shock valve or shock absorber consists of a spring weighted plunger extending through a stuffing box into a valve body. This plunger when suddenly moved upward, through a shock in the pipe line, will displace sufficient volume of water forming at the same time a cushion, thus preventing expansion in the pipe line or other parts of the hydraulic system.

Wherever it is possible, the loop system should be employed when laying out a new pipe line. This will eliminate dead ends in the line.

### Cooling of Exhaust Water

Due to friction caused by the large velocity of high pressure water passing through pipe lines, fittings and valves, the temperature of the water will rise considerably. Hot or warm water is very detrimental to the packing of hydraulic cylinders, stuffing boxes and valve packings.

Therefore, in a closed system where the exhaust water is used over again, large pipe sizes both for pressure and exhaust should be provided and the exhaust water should be returned to a large suction tank. This pump suction tank should have a capacity of at least ten times the capacity of the pump, based on pumping capacity in gallons per minute. Pump suction tanks should be open on top to allow for vapors to escape.

It is very important that the suction pipe should be connected to the suction tank at a position at least 1 in. above the bottom of the suction tank so no sediment or foreign matter, which may be in the suction tank, will enter the suction pipe.

### Freezing

To prevent pipe lines from freezing in cold weather, all outside pipe lines should be laid in the ground below the frost line, pits to be provided where pipe joints are located.

Where the pipe line is exposed, steam coils or stoves will keep the room temperature above the freezing point. In a closed system anti-freezing solution (soluble animal oil or glycerine) should be added to the water in the pipe.

---

## Reducing Valves

In case a reducing valve is located overhead or in an out-of-the-way place, put a light rod on the end of the lever reaching down to a point within reach of the operating floor, so that the weights can be put on or removed quickly and conveniently. If the reducing valve is located in a sub-basement, a little ingenuity can be used in arranging for a cord and pulleys or other means for enabling the operator to handle the weights from the operating floor.

Flexible rubber diaphragms should be protected by a water seal at all times when used on steam reducing valves and special pains should be taken to see that a water seal of ample capacity is maintained on a rubber diaphragm when it is used in connection with oil pressure and other liquids or acids that are detrimental to rubber diaphragms and diaphragms of similar material. A diaphragm made of phosphor bronze is used in many cases.

### Use Relief Valve

Working under the best of operating conditions, things sometimes go wrong and in order to guard against an excess pressure on the service side of the valve, a suitable and reliable relief valve should be placed on the outlet side of all reducing valves.

Heating·Piping
and Air Conditioning

# American Society of Heating and Ventilating Engineers

# JOURNAL SECTION

MARCH 1930

Material in the Section prepared by Publication Committee: G. L. Larson, *Chairman*; H. H. Angus, and W. A. Rowe ; A. V. Hutchinson, Manager of Publications

## *Table of Contents*

36th Annual Meeting, Philadelphia, January 28 to 31, 1930..233
Entertainment at Philadelphia Meeting.....264
First International Heating and Ventilating Exposition....266
Local Chapter Reports.....271
Candidates for Membership.....274
Candidates Elected .....276

## OFFICERS AND COUNCIL—1930

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
29 West 39th St., New York, N. Y.

*President* .....L. A. HARDING
*First Vice-President* .....W. H. CARRIER
*Second Vice-President* .....F. B. ROWLEY
*Treasurer* .....C. W. FARRAR
*Secretary* .....A. V. HUTCHINSON
*Technical Secretary* .....P. D. CLOSE

### COUNCIL

L. A. HARDING, *Chairman* — W. H. CARRIER, *Vice-Chairman*

*One Year*

H. H. ANGUS — N. W. DOWNES — ROSWELL FARNHAM — THORNTON LEWIS — W. T. JONES

*Two Years*

E. B. LANGENBERG — G. L. LARSON — F. C. MCINTOSH — W. A. ROWE

*Three Years*

D. S. BOYDEN — R. H. CARPENTER — J. D. CASSELL — JOHN HOWATT

### COMMITTEES OF THE COUNCIL

*Executive:* W. H. CARRIER, *Chairman*
JOHN HOWATT — E. B. LANGENBERG

*Finance:* F. C. MCINTOSH, *Chairman*
W. T. JONES — THORNTON LEWIS

*Membership:* J. D. CASSELL, *Chairman*
ROSWELL FARNHAM — N. W. DOWNES

*Publication:* G. L. LARSON, *Chairman*
H. H. ANGUS — W. A. ROWE

### ADVISORY COUNCIL

Thornton Lewis, *Chairman;* Homer Addams, F. Paul Anderson, R. P. Bolton, S. E. Dibble, W. H. Driscoll, H. P. Gant, John F. Hale, H. M. Hart, E. Vernon Hill, J. D. Hoffman, S. A. Jellett, D. D. Kimball, S. R. Lewis, J. I. Lyle, J. R. McColl, D. M. Quay, C. L. Riley, F. R. Still and A. C. Willard

### SPECIAL COMMITTEES

*Committee on Meetings Program:* A. C. Willard, *Chairman;* R. H. Carpenter and C. F. Eveleth.

*Committee on Code for Testing Unit Heaters:* D. E. French, *Chairman;* L. C. Soule, W. A. Rowe and H. W. Page.

## COMMITTEE ON RESEARCH

F. B. ROWLEY, *Chairman*

R. S. FRANKLIN, *Vice-Chairman* — F. C. HOUGHTEN, *Director* — T. J. DUFFIELD, *Executive Secretary*

O. P. HOOD, *Ex-Officio Member*

*One Year*

A. R. ACHESON, D. S. BOYDEN, R. V. FROST, C. A. BOOTH, F. B. ROWLEY

*Two Years*

O. W. ARMSPACH, R. S. FRANKLIN, F. E. GIESECKE, C. V. HAYNES, A. P. KRATZ, A. E. STACEY

*Three Years*

W. T. JONES, J. F. MCINTIRE, F. N. SPELLER, A. C. WILLARD

---

# OFFICERS OF LOCAL CHAPTERS

## 1929-30

### CLEVELAND
Headquarters, Cleveland

*Meets: Second Friday in Month*

*President*, W. C. KAMMERER
1301 Citizens Bldg.

*Secretary*, R. G. DAVIS
887 Nela View Rd.

### ILLINOIS
Headquarters, Chicago

*Meets: Second Monday in Month*

*President*, H. G. THOMAS
549 W. Washington Blvd.

*Secretary*, C. W. DELAND
211 N. Desplaines St.

### KANSAS CITY
Headquarters, Kansas City, Mo.

*Meets: Second Monday in Month*

*President*, C. C. CLEGG
311 Mutual Bldg.

*Secretary*, F. A. KITCHEN
1011 Pioneer Trust Bldg.

### MASSACHUSETTS
Headquarters, Boston

*Meets: First Monday in Month*

*President*, T. F. MCCOY
125 St. Botolph St.

*Secretary*, J. S. WEBB
Statler Bldg., Rm. 517

### MICHIGAN
Headquarters, Detroit

*Meets: First Monday after the 10th of the Month*

*President*, W. G. BOALES
1346 Broadway, Rm. 502

*Secretary*, E. H. CLARK
606 Michigan Theatre Bldg.

### MINNESOTA
Headquarters, Minneapolis

*Meets: Second Monday in Month*

*President*, E. F. JONES
301 Zenith Bldg.
St. Paul, Minn.

*Secretary*, M. S. WUNDERLICH
2095 James St., St. Paul

### NEW YORK
Headquarters, New York

*Meets: Third Monday in Month*

*President*, E. J. RITCHIE
183 Madison Ave.

*Secretary*, E. B. JOHNSON
154 Wardwell Ave., W. New Brighton, S. I.

### WESTERN NEW YORK
Headquarters, Buffalo

*Meets: First Monday in Month*

*President*, F. H. BURKE
677 Ellicott Sq.

*Secretary*, D. J. MAHONEY
503 Franklin St.

### ONTARIO
Headquarters, Toronto, Can.

*Meets: First Monday of Month*

*President*, M. BARRY WATSON
25 Bloor St.

*Secretary*, J. PATERSON
155 College St.

### PACIFIC NORTHWEST
Headquarters, Seattle, Wash.

*Meets: Second Thursday in Month*

*President*, E. L. WEBER
723 Seaboard Bldg.

*Secretary*, M. ANDERSON
246 Westmont Way

### PHILADELPHIA
Headquarters, Philadelphia

*Meets: Second Thursday in Month*

*President*, A. C. EDGAR
1202 Locust St.

*Secretary*, L. C. DAVIDSON
810 Land Title Bldg.

### PITTSBURGH
Headquarters, Pittsburgh

*Meets: First Monday in Month*

*President*, H. LEE MOORE
927 Union Trust Bldg.

*Secretary*, W. W. TEAGUE
4800 Forbes St.

### ST. LOUIS
Headquarters, St. Louis

*Meets: First Wednesday in Month*

*President*, E. A. WHITE
5244 Nottingham

*Secretary*, PAUL SODEMANN
4947 Cote Brilliante Ave.

### WISCONSIN
Headquarters, Milwaukee

*Meets: Third Monday in Month*

*President*, FRED G. WEIMER
1308 Stowell Ave.

*Secretary*, V. A. BERGHOEFER
1640 Holton St.

# 36th Annual Meeting, Philadelphia, January 28 to 31, 1930

BENJAMIN FRANKLIN, our patron saint, would have marvelled at the developments which have taken place in the heating and allied arts since he invented the first stove, had he attended the 36th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, at the Benjamin Franklin Hotel, Philadelphia, January 28 to 31, 1930.

Philadelphians are noted for their hospitality, ingenuity, aggressiveness—and successful meetings of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. The 36th Annual Meeting was no exception to the rule, and while it might be said that the International Heating and Ventilation Exposition, held in conjunction with the Annual Meeting, was somewhat responsible for the unprecedented registration of 1093, and which more than doubled that of any preceding meeting, it is also true that the previous record for registration was held by Philadelphia for nine years, and this record was obtained without the stimulus of an exposition. The registration included 518 members, 415 guests and 160 ladies.

Endless praise is due the committee for the efforts put forth during the two years they worked to make this affair the outstanding success that it was. It was a never-to-be-forgotten experience for those who had the good fortune to attend.

Seven sessions were held during the four-day meeting, the morning sessions being held at the Benjamin Franklin Hotel, and the afternoon sessions at the Commercial Museum. The Code for Rating Steam Heating Boilers occupied the attention of the assemblage during one of the sessions, while another session was devoted largely to unit heaters and to a testing and rating code relating thereto. Heat transmission, salvaging of steam, infiltration, hot water heating systems, temperature regulation, air conditioning and fan furnace heating, were the subjects discussed in the papers presented.

The activities of the research department were discussed, and the announcement made regarding the appointment of T. J. Duffield as Executive Secretary of the Research Committee, which was hailed as an important and progressive step in the activities of the SOCIETY.

## First Session—Tuesday, January 28—9:30 A. M.

The first session was called to order by Pres. Thornton Lewis, and greetings in behalf of the Philadelphia Chapter were extended by J. D. Cassell, Honorary Chairman of the Committee on Arrangements. The response was made by Vice-Pres. L. A. Harding, after which R. C. Bolsinger, Chairman of the Committee on Arrangements outlined the program and entertainment features of the meeting. President Lewis read communications from the Hon. R. P. Lamont, Secretary of Commerce of the United States, August Beaurrienne, Paris, France, a member of the SOCIETY, H. G. Thomas, President of the Illinois Chapter and the Philadelphia Chamber of Commerce.

R. A. Wolff, chairman of the Tellers of Election, presented the following report:

### Report of Tellers of Election

The Board of Tellers of Election appointed by President Thornton Lewis, have examined the ballots of members eligible to vote and take pleasure in rendering the following report:

For President—L. A. Harding, 674.

For First Vice-President—W. H. Carrier, 672.

For Second Vice-President—F. B. Rowley, 675.

For Treasurer—C. W. Farrar, 671.

For Members of the Council (for 3 years)—R. H. Carpenter, 673; J. D. Cassell, 672; Alfred Kellogg, 672; John Howatt, 675.

Members of Committee on Research—C. V. Haynes, 660; W. T. Jones, 666; J. F. McIntire, 665; F. N. Speller, 663; A. C. Willard, 662.

Scattering votes were recorded for various other members.

Tellers of Election.

R. A. WOLFF,
J. V. CAVILEER,
W. R. MURPHY.

The President's Report was then read by Mr. Lewis, as follows:

### Report of President

First, I desire to thank the officers, the Presidents of the Chapters, the Chairmen and all the members of our various committees. All that this administration has accomplished is due to their loyalty to the SOCIETY and their untiring efforts in its behalf.

Particular mention should be made of the work of W. T. Jones, Chairman of the Finance Committee; Samuel R. Lewis, Chairman of the Guide Publication Committee; our Vice-President, L. A. Harding, who with his associates, R. V. Frost and F. C. Houghten, has worked so faithfully on the Boiler Rating Code; Prof. A. C. Willard, Chairman of the Publication Committee.

Cecil W. Farrar's work as Chairman of the Increase of Membership Committee speaks for itself. Through his efforts a number of members have been added to our roll. We now have the largest membership in the history of the SOCIETY.

H. P. Gant, Chairman of the International Heating and Ventilating Exposition Committee, has, I am sure you will agree, done a splendid job and the Exposition will be a credit to the managers of the International Exposition Co. and to the SOCIETY.

Last, but by no means least, I desire to mention the effective, efficient and untiring work of our Secretary, A. V. Hutchinson. He never forgets, never overlooks anything which the President should do. He is everywhere and anywhere he is needed or that a job is to be done for the SOCIETY. I fear our members who have not worked closely with our New York headquarters, do not fully appreciate the versatility and general ability of Mr. Hutch-

inson. May I commend Mr. Harding to his good ministrations.

Your President has visited all the Chapters excepting only the one on the Pacific Coast.

There are no recommendations to the SOCIETY that I wish to leave on record; perhaps they never would be read, anyway. The policies inaugurated by this administration, if good, will continue; if not, they deserve to meet a timely end.

May I, however, summarize the chief thoughts which have actuated your President:

1st—To encourage the establishment of a Society Endowment Fund.

2nd—To further co-operation with other organizations, such as the U. S. Public Health Service, the *Heating and Piping Contractors National Association*, the *National Warm Air Heating Association*, the *American Oil Burner Association*, the *National Association of Fan Manufacturers*, the *Boiler and Radiator Institute*, the *Industrial Unit Heater Manufacturers Association* and many others.

3rd—To urge all members to interest the younger men of our industry in becoming members of our SOCIETY. They need the SOCIETY today, and we need them, for they will be the engineers, executives and manufacturers of tomorrow.

Conscious of the honor you have done me, the support you have given me, and the generosity of thought bestowed in judging my actions, may I show a slight bit of my appreciation by making this the shortest Presidential report on record.

The first paper, entitled Power from Process and Space Heating Steam, was presented by the author, L. A. Harding, in which it was pointed out that, if steam is generated for process work and is not passed through a steam generator for the manufacture of power, it is a waste. He stated that this is one of the greatest sources of waste in the United States. (Complete paper published in November 1929 A. S. H. V. E. JOURNAL.)

Prof. W. M. Sawdon and Perry West expressed their appreciation of this paper and Mr. West inquired about the apparent difference between the theoretical water rate given in Fig. 3, and the practical water rate given in Fig. 2.

John Meyers suggested a caution with respect to the study of the cycle of operation of the heating and electric loads, and stated that there are two extremes, one of which, is where the steam load and electric loads coincide, and the other, where there is lack of coincidence and the steam must be exhausted to the atmosphere. He further stated that the results to be obtained depend largely upon the accuracy with which the coincidence of the two loads is determined. It had been his experience in a number of cases of which a study had been made of the after-effect, that the actual result obtained was far from the result anticipated by the original analysis, this difference being due largely to failure to take into consideration this cycle of operation.

Webster Tallmadge emphasized two points regarding this paper: first, that the consumption and demand curve be plotted by weeks throughout the year rather than months, on account of the fact that certain abnormal days are likely to distort the figures; second, that very frequently the storing of heat in water in off periods of live steam demand will even out the peak load so that the high water demand and the steam demand do not come together.

F. D. Mensing suggested that *clients* rather than *jobs* be solicited, and pointed out that the use of recording instruments is usually justified by the saving obtained. He stated that in Philadelphia the average mean temperature on January 22 is 31 deg., whereas the average mean temperature six months hence is 67 deg., and while this climate is very satisfactory from the standpoint of averages, it is not so satisfactory from the standpoint of extremes because the temperature ranges from a maximum of 106 deg. to a minimum of —6. Mr. Mensing stated that by means of accumulated charts of operation of a power plant, it is possible to predict the heating load of a power plant for five years in advance with a surprising degree of accuracy.

In closing the discussion, Mr. Harding stated that the explanation of the difference between the ideal or theoretical water rate and the practical water rate is given in Table 5 of the paper in which is indicated the approximate full load efficiencies of a multistage impulse steam turbine of the geared type. The brake potential efficiency ratio, Mr. Harding pointed out, is given in the second column, the generator efficiency in the third column, and the combined efficiency at full load in the last column.

Mr. Harding explained that turbines are no longer rated like steam engines with an overload, as they were 10 years ago, but are now rated at maximum output, and will develop more power than the rated output if extra nozzles are installed on the high-pressure end. He pointed out that the average person does not correct the Willan's line for the decreasing generator efficiency due to the decreasing load. It is usually assumed, he stated, that the efficiency of a generator remains constant over the entire load range of the turbine, and in most cases this assumption is not very far wrong. The author mentioned that an example is given in Table 6 for correcting the Willan's line for the decreasing load. Mr. Harding agreed with Mr. Mensing that flow and watt meters are essential in a plant for an investigation of this nature. He pointed out the difficulty of ascertaining the steam consumption of a large rotary digester, and emphasized the necessity of depending on the flow and watt meter readings in such cases.

H. G. Issertell asked to correct the impression that many engineers have, namely, that turbine manufacturers have become weary of supplying engineers with data. He expressed a willingness to help in every way possible. He emphasized the fact that the matter of water rates is not as definite as many people seem to think.

In answer to Mr. Issertell's remarks, Mr. Harding stated that before a turbine manufacturer can supply the information desired, it is necessary to submit a definite problem to him, but before the definite problem can be submitted it is necessary to go through all of the preliminary steps, which require a great deal of time in order to find out what information is desired. In other words, the engineer does not know what to ask for in many cases.

President Lewis called upon several Past-Presidents of the SOCIETY. The first of these was Stewart

A. Jellett, the first regularly elected President of the SOCIETY, who gave reminiscences of the early days in the organization, including the handicaps with which they had to contend. He expressed great personal satisfaction in being one of those who had a hand in establishing the SOCIETY.

J. R. McColl made a few remarks apropos of the occasion, as did Samuel R. Lewis, who has served the SOCIETY in many capacities, the most recent of which was that of Chairman of the Guide Publication Committee, Dr. E. Vernon Hill, Prof. S. E. Dibble of Carnegie Tech, and Dean F. Paul Anderson of the University of Kentucky, who in addition to being a Past-President, is also former Director of the Research Laboratory. Dean Anderson expressed the hope that his interest in the SOCIETY will be eternal. He stated that in his opinion the Exposition was one of the finest presentations of industrial and scientific matters ever held in this country.

J. J. Wilson, a charter member of the SOCIETY, was also called on by President Lewis, and expressed his amazement on the extent of the assembly and the character of the papers to be presented.

Two reports, that of the Council and Secretary, were read by A. V. Hutchinson, Secretary, as follows:

## Report of Secretary

With the expansion of the SOCIETY's activities and the necessarily increased staff, 1929 has been productive in the completion of a number of SOCIETY projects, which have been under discussion and preparation for a considerable time. An unusual burden has been successfully handled in the installation of a new system of records in the Headquarters Office, and 50 per cent more membership applications were handled than in the year previous.

The numerous details connected with the change in publication method of THE JOURNAL of the SOCIETY during two-thirds of the year have been successfully handled through the splendid co-operation of the publishers and the staff.

Since the last meeting, the Code of Minimum Requirements for the Heating and Ventilation of Buildings has been printed and mailed, as well as Volumes 33 and 34 of the TRANSACTIONS for 1927 and 1928, a Code for Testing and Rating Steam Unit Heaters has been prepared and distributed to the membership, as well as the Report of the Continuing Committee on Testing and Rating Low Pressure Heating Boilers.

The Secretary has had the opportunity of visiting every Chapter except the Pacific Northwest group and has greatly enjoyed the personal contact with the members.

The interest in Chapter activities is particularly keen at the present and inquiries have come from Baltimore, Montreal, Los Angeles and San Francisco about the possibility of establishing Chapters in those cities.

The rapid advance of the heating and ventilating industry, which is so graphically demonstrated in the Exposition, has stimulated interest in many quarters, and it is especially noticeable in the number of colleges that are establishing heating and ventilating classes and also doing research in heating and ventilating problems.

The necessity for greater outside contacts by the SOCIETY is evident if the organization is to maintain its leadership.

## Report of the Council

Since the organization meeting, January 31, 1929, in Chicago, the Council has held seven meetings and passed on many important questions affecting the operation of the SOCIETY with the result that the organization is found at a high point in its career in respect to strength of membership and financial stability.

A number of special committees were appointed on specific problems, among which were the Committee to Establish a Society Endowment Fund, Committees to Prepare Code for Testing Unit Heaters, Concealed Radiators, Unit Ventilators, and a Committee on Natural Ventilation.

One of the special problems of the Council is the increase of membership and the retaining of the interest of the older members.

A special committee, headed by C. W. Farrar, was assigned to interest the right kind of men who would qualify to join the SOCIETY, and another committee, headed by F. D. Mensing, was assigned the difficult problem of communicating with delinquent members.

The results in both cases have been most gratifying and the members are indebted to these committees for their splendid work.

Matters of special importance to the membership were the change in the monthly JOURNAL of the SOCIETY and its incorporation as a part of the magazine, Heating, Piping & Air Conditioning, starting in May, 1929; arrangements for the Heating and Ventilating Exposition; and the participation of the SOCIETY in the World Engineering Congress at Tokio, where a paper was presented by W. H. Carrier and prepared by a committee of members of the SOCIETY under the direction of Mr. Carrier.

One of the important actions taken by the Council was in reference to the issuance of publicity material by the U. S. Public Health Service, resulting in a conference by a committee of SOCIETY members and Surgeon General Cummings, resulting in the preparation of a bulletin in co-operation with members of the Public Health Service, giving the present status of ventilation standards for application in schoolroom heating and ventilating.

The Council accepted the invitation of the Minnesota Chapter to hold the Semi-Annual Meeting 1930 in Minneapolis, and through its committee handled routine assignments of budget preparation, election of members, and publication of Transactions and technical meeting programs.

Through the individual reports of various Council Committees, the SOCIETY members will find that the activities of the SOCIETY have been of greater scope this year than in any other year, that the assets of the SOCIETY have increased over the previous year, and that the gain in the SOCIETY's General Fund through profits of the Publication Department have been substantially increased.

The opportunity for the SOCIETY to perform greater public service is evidenced by the interest of the public in its activities and the substantial increase in membership resulting this year indicates that the SOCIETY's service to the individual member is recognized.

President Lewis paid tribute to the work of Cecil Farrar, Chairman of the Committee on Increase of Membership, for the enthusiasm he has put into the work. He called attention to the fact that Mr. Farrar, together with the President and Secretary, have visited nearly every Chapter in the country. Mr. Farrar then told of the work of his Committee, stating that for some time there had been no increase in the membership of the SOCIETY, and that the Committee had increased the membership about 10½ per cent. He stated that it was really an easy matter to secure members. A total of 195 applications were accepted, the high Chapter being Michigan. Mr. Farrar expressed great enthusiasm as to the possibility of further increasing the membership of the SOCIETY, and advanced the opinion that at least 500 members could have been secured in the campaign just ended had there been sufficient time.

President Lewis then elaborated upon the work of Mr. Farrar's Committee, and stated that Mr. Farrar had been somewhat modest in speaking of the accomplishments. He pointed out that the Committee

secured a total of 363 applications, 75 of whom have affiliated since the first of the year, 166 having affiliated before the first of the year, so that although 1930 was started with 1995 members, a gain of only seven over January 1, 1929, the result of Mr. Farrar's work was just beginning to show, and since January 1, 1930, 75 members have affiliated, making the membership 2070, the largest in the history of the organization. There are 122 applications upon which the Membership Committee have not acted, because they have come in so recently.

### Report of Committee to Investigate Cause of Loss of Membership in the Society

Your committee on Loss of Membership would report that in compliance with the request of your president, Thornton Lewis, it made investigations into the reasons underlying the loss of membership due to accumulated back dues, and finally summed the reasons as follows:

1. Loss of interest in the Society due to change in business and like causes.
2. A feeling of resentment against the Society due to a misunderstanding of the Constitution and By-Laws of the Society.
3. Financial difficulties due to unemployment.

The approach in all cases was made to the delinquent members by means of friends, more particularly the proposers or seconders to the petitions of the delinquent members when this was possible. The financial returns of this campaign have been most satisfactory.

This can be best exemplified in its relation to its work in the Research Laboratory. The Laboratory, as you know, gets 40 per cent of the membership dues. The returns to the Research Laboratory for the past three years are as follows:

| | |
|---|---|
| 1927 | $13,513.54 |
| 1928 | 12,722.96 |
| 1929 (paid and due) | 209,494.52 |

January 28, 1930. *F. D. Mensing.*

H. P. Gant, a Past-President of the Society, and Chairman of the Advisory Committee of the International Heating and Ventilating Exposition, then spoke of the activities relative to the Exposition. He requested suggestions and criticisms from those who attended the Exposition in order that they may be submitted to the management for improving future expositions of the Society.

## Second Session—Tuesday, January 28—2:30 P. M.

President Lewis expressed appreciation for the excellent work of W. T. Jones, Chairman of the Finance Committee, and stated that those who have not been intimately in contact with the work of the Headquarters Office have failed to realize how much unselfish service such men as Mr. Jones have rendered to the Society. He drew attention to the fact that it is not this type of work that makes a show, but that many hours of diligent work and planning for the benefit of the Society were given by Mr. Jones.

### Report of the Finance Committee

Mr. Jones explained the difficulty of obtaining a complete audit between the time of closing the books on January 1, and the day of the report of his Committee on January 28. He then submitted in abstract the report of the Finance Committee, bringing out the important features of the operating statements of Society and Publication activities as summarized by the accountant.

President Lewis added that the agreement with the publishers of the Journal of the Society had resulted in a profit to the Society of over $7,000 on eight months' operation after deducting the cost of members' subscriptions.

*FRANK G. TUSA*
*Certified Public Accountant*
*Audits — Tax Service — Systems*
*Italian Savings Bank Building*
*New York*

January 21, 1930.

*American Society of Heating and Ventilating Engineers,*
*29 West 39th Street,*
*New York City.*

Gentlemen:

Pursuant to your request I made an examination of the books of account and records of the American Society of Heating and Ventilating Engineers, New York City, for the year ended December 31, 1929, and submit herewith the following exhibits and comments:

*Exhibit*

"A" Balance Sheet, December 31, 1929.
Schedule No. 1—Marketable Securities.

"B" Statement of Income and Expenses of the Society for the Year Ended December 31, 1929.
Schedule No. 5—Salaries.

"C" Statement of Income and Expenses of the Publications for the Year Ended December 31, 1929.
Schedule No. 2—Cost of Journal.
Schedule No. 3—Cost of Guide.
Schedule No. 4—Transactions.
Schedule No. 5—Salaries.

"D" Comparison of Budget, Society Activities.

"E" Comparison of Budget, Publications.

*Cash*

The Cash on Deposit was verified by direct communication with the following banks and reconcilement of the amount reported to me with the balances shown by the books of the Society:

| | |
|---|---|
| Bankers Trust Company, 42nd Street and Fifth Avenue, New York City | $5,146.74 |
| Bank of America, N. A., 40th Street and Madison Avenue, New York City | 1,437.43 |
| Total | $6,584.17 |

A count was also made of the Petty Cash on hand and found in agreement with the General Ledger Imprest Fund account.

*Marketable Securities*

A schedule showing a list of investments made by the Society in Marketable Securities kept with the Bankers Trust Company for safekeeping is included as part of this report. The shrinkage in market value of the securities as of the close of business, December 31, 1929, of $4,554.03 is not reflected in the attached Balance Sheet.

*Accounts Receivable*

A trial balance was taken of the Dues Receivable from members as of December 31, 1929, and classified as to the year invoiced. A summary of the dues is shown below:

| | |
|---|---|
| 1929 Unpaid Dues | $ 7,605.15 |
| 1928 " " | 2,822.50 |
| 1927 " " | 1,089.53 |
| Dues Receivable | $11517.18 |

Dues amounting to $477.09, which had been prepaid during the past year, are shown on the attached Balance Sheet as a deferred income. After reviewing in detail all available data concerning the collectibility of 1929 unpaid dues a reserve in the amount of $3,602.08 was provided. This, together with the balance of the Reserve carried forward from the previous year in my opinion will be ample to cover probable losses in the realization of all Dues Receivable.

The membership of the SOCIETY on December 31, 1929, comprised the following:

| | |
|---|---|
| Members | 1,424 |
| Associates | 405 |
| Juniors | 156 |
| Students | 1 |
| Honorary | 2 |
| | 1,988 |

Trial balances of all other Accounts Receivable were also taken and the proper reserve to cover accounts doubtful of collection provided.

*Inventories*

The Inventory of Transaction taken on December 31, 1929, was submitted for my verification and is scheduled below:

Transactions covering the Years 1928, Volume 34, and 1929, Volume 35, were not published up to the close of business, December 31, 1929, therefore reserves in the amount of $2,500.00 and $3,000.00, respectively, have been provided to cover the future cost of producing those volumes.

| YEAR | VOLUME | NUMBER | PRICE | AMOUNT |
|---|---|---|---|---|
| 1922 | 28 | 154 | $1.18-2/5 | $ 182.34 |
| 1923 | 29 | 125 | 1.97½ | 246.87 |
| 1924 | 30 | 222 | 1.38¼ | 306.92 |
| 1925 | 31 | 181 | .96-1/6 | 174.06 |
| 1926 | 32 | 117 | 1.26-4/5 | 148.36 |
| 1927 | 33 | 349 | 1.32-1/5 | 461.38 |
| | | | | $1,519.93 |

A verification of the Inventories and Deferred Charges to future operations was made either by computation or actual count.

*Accounts Payable*

A list was compiled of all invoices remaining unpaid on December 31, 1929, dating prior to January 1, 1930, for the purpose of determining all Accounts Payable and a liability therefor was set up in the sum of $17,768.71. This sum includes charges from Horn-Shafer Co. of $14,410.00 for costs covering the printing of the Guide and Year Book.

*Due Research Laboratories*

Of the dues charged to Senior and Associates 40 per cent has been reserved for the Research Laboratory in accordance with Section 5, Article 3 of the By-Laws. The sum payable to the Research Laboratory as and when the Dues Receivable will have been realized in cash is $16,465.82. In addition, there is due the Research Laboratory the sum of $4,973.50, representing that portion of the profit resulting from the Guide, which has been computed as follows:

| | | |
|---|---|---|
| *INCOME FROM GUIDE* | $46,348.78 | |
| *COST OF GUIDE* | 33,414.04 | |
| GROSS PROFIT | | $12,934.74 |
| *OVERHEAD EXPENSE* | | |
| Amount charged to Guide Calendar Year 1928 | $ 2,222.14 | |
| ADD: One-half of Increase of 1929 Expenses over 1928 | 1,634.46 | 3,856.60 |
| | | $ 9,078.14 |
| DEDUCT: Chapter Meeting Expenses | | 1,000.00 |
| | | $8,078.14 |
| Bonus to Publication Management and Staff (88%) | | 3,104.64 |
| NET PROFIT FROM THE GUIDE FOR RESEARCH LABORATORY | | $ 4,973.50 |

*Accrued Accounts*

There has been determined a bonus of $3,528.00 to be paid to the publication management and staff which has been deducted as an expense in the Statement of Income and Expenses from the Publications.

*Funds*

A resolution of council provides that there be set up a publication fund for all gross revenue derived from the Journal during the period from May 1 to December 31, 1929, and in accordance therewith the sum of $10,666.70 realized has been shown as the publication fund on the attached Balance Sheet. An analysis of the funds of the SOCIETY reflecting the changes that occurred therein during the past year is shown on the following page:

| | | |
|---|---|---|
| FUND—DECEMBER 31, 1928, PER FORMER REPORT | | $35,416.95 |
| ADD: Profit from Publications for the year ended December 31, 1929, from Statement of Income and Expenses | $ 4,611.11 | |
| DEDUCT: Loss on Society Operations for the year ended December 31, 1929 from Statement of Income and Expenses | 769.80 | |
| NET PROFIT FOR THE YEAR | | 3,841.31 |
| FUNDS—DECEMBER 31, 1929, PER BALANCE SHEET | | 39,258.26 |
| LESS: PUBLICATION FUND | | 10,666.70 |
| GENERAL FUND—DECEMBER 31, 1929, PER BALANCE SHEET | | $28,591.56 |

Respectfully submitted,

*Frank G. Tusa,*
Certified Public Accountant.

BALANCE SHEET

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS—NEW YORK CITY

DECEMBER 31, 1929

ASSETS

| | | | | |
|---|---|---|---|---|
| CASH | | | | |
| On Deposit—General Fund | | $ 6,584.17 | | |
| On Deposit—Research Fund | | 1,680.54 | $ 8,264.71 | |
| On Hand | | | 100.00 | $ 8,364.71 |
| MARKETABLE SECURITIES—PER SCHEDULE | | | | |
| General Fund | | 25,596.53 | | |
| ADD: Accrued Interest | | 765.63 | 26,362.16 | |
| Research Fund | | | 3,045.61 | 29,407.77 |
| ACCOUNTS RECEIVABLE | | | | |
| Dues | | 11,517.18 | | |
| LESS: Reserve for Doubtful | | 7,358.08 | 4,159.10 | |
| Advertisements | $37,423.79 | | | |
| Guides | 1,255.00 | | | |
| Codes | 326.00 | | | |
| Reprints | 99.74 | 39,104.53 | | |
| LESS: Reserve for Doubtful | | 1,000.000 | 38,104.53 | 42,263.63 |
| INVENTORIES | | | | |
| Transactions | | | 1,519.93 | |
| Transactions Paper | | | 524.68 | |
| Pictures | | | 72.00 | |
| Emblems | | | 95.87 | |

| | | |
|---|---|---|
| Reprints and Books | 98.45 | |
| Code of Minimum Requirements | 543.31 | 2,854.24 |
| LIBRARY | | 300.00 |
| FURNITURE AND FIXTURES | 5,794.50 | |
| LESS: Reserve for Depreciation | 3,290.25 | 2,504.25 |
| DEFERRED CHARGES | | |
| Publications—Mailing | 1,412.34 | |
| Prepaid Local Chapter Expenses | 500.00 | 1,912.34 |
| | | $87,606.94 |

LIABILITIES

| | | | |
|---|---|---|---|
| ACCOUNTS PAYABLE | | | $17,768.71 |
| DUE RESEARCH LABORATORY. | | | |
| Dues | | $11,307.73 | |
| 1929 Guide Profit | | 4,973.50 | |
| Interest on Securities | | 67.50 | 16,348.73 |
| ACCRUED ACCOUNTS | | | |
| Bonus—Publication Management and Staff | | | 3,528.00 |
| RESERVE FOR TRANSACTIONS | | | |
| 1928 | | 2,500.00 | |
| 1929 | | 3,000.00 | 5,500.00 |
| DEFERRED INCOME | | | |
| Prepaid Dues | | | 477.09 |
| FUNDS | | | |
| General | $28,591.56 | | |
| Publications | 10,666.70 | 39,258.26 | |
| Research | | 4,726.15 | 43,984.41 |
| | | | $87,606.94 |

*Note "A"*—There were no contingent liabilities reported to me and as far as could be ascertained none existed.

*Note "B"*—This Balance Sheet is subject to the comments contained in the letter attached to and forming a part of this report.

BUDGET COMPARISON—SOCIETY ACTIVITIES

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS—NEW YORK CITY

FOR THE YEARS INDICATED BELOW

| BUDGETED INCOME | ACTUAL 1928 | ACTUAL 1929 | BUDGET PROVISION | INCREASES DECREASES |
|---|---|---|---|---|
| 1929 Dues Income | $24,738.49 | $25,906.25 | $25,000.00 | $906.25 |
| Prior Years Dues Realized | 5,072.55 | 4,005.12 | 6,000.00 | 1,994.88 |
| Initiation Fees | 2,499.00 | 3,845.00 | 3,000.00 | 845.00 |
| Sale of Emblems and Certificate Frames | 237.50 | 310.41 | 250.00 | 60.41 |
| Sale of Code of Minimum Requirements | 0 | 3,165.82 | 5,000.00 | 1,834.18 |
| Interest Earned | 1,175.14 | 2,002.77 | 1,200.00 | 802.77 |
| Profit from Sale of Securities | 200.00 | 0 | 0 | 0 |
| TOTALS | $33,922.68 | $39,235.37 | $40,450.00 | $ 1,214.63 |
| BUDGETED EXPENSES | | | | |
| Salary—Secretary | $ 2,750.00 | $ 3,600.00 | $ 3,600.00 | 0 |
| Salary—Clerical | 5,420.00 | 5,655.66 | 6,000.00 | $344.34 |
| Rent | 1,000.00 | 1,000.00 | 1,000.00 | 0 |
| Professional Services | 360.00 | 450.00 | 400.00 | 50.00 |
| Postage | 1,219.84 | 1,643.38 | 1,500.00 | 143.38 |
| General Printing | 970.36 | 1,836.87 | 1,000.00 | 836.87 |
| Yearbook | 862.78 | 721.37 | 850.00 | 128.63 |
| Cost of Emblems and Certificate Frames | 113.31 | 351.52 | 140.00 | 211.52 |
| Traveling—Secretary | 1,335.90 | 1,121.47 | 1,000.00 | 121.47 |
| Traveling—President | 687.51 | 1,000.00 | 1,000.00 | 0 |
| Traveling—Technical Secretary | 0 | 136.20 | 250.00 | 113.80 |
| Meetings—Annual and semi-annual | 3,099.58 | 2,747.25 | 3,000.00 | 252.75 |
| Local Chapter Meeting Allowance | 1,000.00 | 1,000.00 | 1,000.00 | 0 |
| Special Council and Committees | 358.17 | 981.53 | 1,000.00 | 18.47 |
| Exhibit—Power Show | 64.35 | 95.90 | 100.00 | 4.10 |
| Allowance for Member's Journal Subscriptions | 3,966.00 | 2,982.00 | 3,000.00 | 18.00 |
| Allowance for Members' Transaction Subscriptions | 1,983.00 | 2,982.00 | 3,000.00 | 18.00 |
| Due | 60.00 | 60.00 | 60.00 | 0 |
| Special Boiler Code | 568.41 | 671.48 | 500.00 | 171.48 |
| Code of Minimum Requirements | 3,584.52 | 3,060.21 | 2,500.00 | 560.21 |
| APPORTIONABLE EXPENSES | | | | |
| Rent | 1,577.85 | 1,282.82 | 1,340.00 | 57.18 |
| Office Expenses | 1,385.46 | 1,395.18 | 1,380.00 | 15.18 |
| Office Supplies | 430.52 | 200.46 | 480.00 | 279.54 |
| Allowance for Depreciation of Furniture and Fixtures | 271.80 | 347.67 | 300.00 | 47.67 |
| | 33,069.36 | 35,522.97 | 34,400.00 | 922.97 |
| UNBUDGETED EXPENSES | | | | |
| Publicity Expenses | 195.73 | 69.00 | 0 | 69.00 |
| Unit Heater Code | 0 | 223.08 | 0 | 223.08 |
| Moving Technical Secretary | 0 | 385.00 | 0 | 385.00 |
| | 195.73 | 677.08 | | 677.08 |
| | $33,265.09 | $36,000.05 | $34,400.00 | $1,600.05 |

*Exhibit "D"*

BUDGET COMPARISON—PUBLICATIONS

AMEPICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS—NEW YORK CITY

FOR THE YEARS INDICATED BELOW

| INCOME JOURNALS | 1928 | 1929 | BUDGET PROVISION | INCREASES DECREASES |
|---|---|---|---|---|
| Advertising | $21,802.15 | $ 6,206.92 | $ 5,500.00 | $ 705.92 |
| Sale of Journals | 1,087.38 | 191.90 | 100.00 | 91.90 |
| Editorial Contract | 0 | 7,584.02 | 8,000.00 | 415.98 |
| Members' Subscriptions | 3,966.00 | 2,982.00 | 3,000.00 | 18.00 |
| | 26,855.53 | 16,964.84 | 16,600.00 | 364.84 |
| TRANSACTIONS | | | | |
| Members' Subscriptions | 1,983.00 | 2,982.00 | 3,000.00 | 18.00 |
| Copy Sales | 259.61 | 286.17 | 500.00 | 213.83 |
| | 2,242.61 | 3,268.17 | 3,500.00 | 231.83 |
| GUIDE | | | | |
| Advertising | 31,539.94 | 33,879.28 | 33,500.00 | 379.28 |
| Sale of Guides | 6,010.28 | 12,469.50 | 7,500.00 | 4,969.50 |
| | 37,550.22 | 46,348.78 | 41,000.00 | 5,348.78 |
| SALE OF REPRINTS AND BOOKS | 846.48 | 1,064.04 | 400.00 | 664.04 |
| | 846.48 | 1,064.04 | 400.00 | 664.04 |
| TOTALS | $67,494.84 | $67,645.83 | $61,500.00 | $ 6,145.83 |
| COSTS AND EXPENSES | | | | |
| COST OF PUBLICATIONS | | | | |
| Journal | $14,297.93 | $ 4,248.37 | $ 4,500.00 | $ 251.63 |
| Guide | 25,385.30 | 33,414.04 | 23,600.00 | 9,810.04 |
| Transactions | 2,620.31 | 3,023.45 | 2,500.00 | 523.45 |
| Reprints and Books | 722.66 | 672.20 | 300.00 | 372.20 |
| | 43,026.20 | 41,358.06 | 30,900.00 | 10,458.06 |

| | | | | |
|---|---|---|---|---|
| EXPENSES | | | | |
| Salary—A. V. Hutchinson.. | 2,750.00 | 3,600.00 | 3,600.00 | 0 |
| Salary—Clerical..... | 4,074.00 | 5,253.67 | 4,000.00 | 1,253.67 |
| Professional Services..... | 240.00 | 300.00 | 300.00 | 0 |
| Postage..... | 337.77 | 328.02 | 400.00 | 71.98 |
| Traveling—A. V. Hutchinson..... | 475.46 | 980.25 | 1,000.00 | 19.75 |
| APPORTIONABLE EXPENSES=40% | | | | |
| Office Expenses..... | 860.83 | 825.92 | 920.00 | 94.08 |
| Office Supplies..... | 122.98 | 133.64 | 320.00 | 186.36 |
| Allowance for Depreciation of Furniture and Fixtures..... | 181.20 | 231.78 | 200.00 | 31.78 |
| | 9,906.24 | 13,175.16 | 12,300.00 | 875.16 |
| TOTALS..... | $52,932.44 | $54,533.22 | $43,200.00 | $11,333.22 |

*Exhibit "E"*

Mr. Lewis read a wireless message received from Alf Tjersland of Oslo, Norway, a member of the SOCIETY, who extended greetings and expressed best wishes for a good meeting.

The first paper of the second session was Pressure Difference Across Windows in Relation to Wind Velocity, by Prof. J. E. Emswiler and W. C. Randall. In the presentation of this paper, Professor Emswiler stated that further information was necessary to answer two questions in connection with the study the SOCIETY has made on infiltration and window leakage. First, what wind velocity should be selected to calculate that part of the heating load due to infiltration. Second, the pressure corresponding to the wind velocity selected is not necessarily the pressure difference or head that produces the leakage through windows.

President Lewis requested a full discussion of the paper. S. H. Givelber asked if any relation had been established between the pressure differences and the effect they have on the temperature in the room. C. G. Segeler pointed out a possible source of difference of opinion regarding this paper, namely, that Professor Emswiler had selected a period of 45 days for both wind velocity and direction, whereas the conclusions might not necessarily be the same if the data had been collected on such days as might be termed maximum heating days, or in other words, days on which the heating system is taxed to the utmost.

Prof. G. L. Larson emphasized the importance of this paper, and suggested the advisability of following up this work. He also dwelt on the phase of the subject brought up by Mr. Segeler relative to the fact that the maximum wind velocity and the minimum temperature do not occur on the same day, and hence that there is some doubt as to what conditions should be used for designing a heating system. Professor Larson stated that the records at the University of Wisconsin indicated that the maximum heating load occurred on the day when the temperature was 4 deg. above zero, although the temperature was considerably below this several times during the heating season, and on one occasion it was 25 below. At these extremely low temperatures, there is practically no wind, Professor Larson stated, so it is questionable as to whether a heating system should be designed on the basis of the minimum temperature and the maximum wind velocity. Professor Larson also asked for information concerning the anemometer readings taken.

Miss Margaret Ingels asked if any data were taken to ascertain whether the difference between the indoor and outdoor temperatures caused a variation in the flow of air through the gravity exhaust, causing different pressures to build up in the room. Mr. Nicholls brought up the question of the direction of the prevailing wind which, at the time the readings were taken, was west and southwest, pointing out that the coldest temperatures do not obtain when the wind is in these directions. This speaker felt that a great deal of guessing was necessary in handling the various factors involved in this problem.

S. R. Lewis told of an experience he had in connection with a 21 story co-operative apartment building in Chicago. Although all of the 21 apartments were the same, the occupants of the second and twenty-first stories complained of insufficient heat, and it was therefore surmised that all of the apartments were insufficiently "radiated." The other tenants, however, objected to installing any additional radiation in their apartments because comfortable temperatures were being maintained. The answer to the problem in this case, Mr. Lewis pointed out, was that on account of the height of the building, infiltration took place in the lower stories, whereas exfiltration took place through the upper stories.

L. A. Harding congratulated the authors on this paper, and stated that originally there were two major problems to be solved, first, to determine the amount of leakage through a crack with a certain pressure difference, and second, to correlate the wind velocity as reported by the Weather Bureau to the actual pressure difference with respect to the building.

The Research Laboratory, Mr. Harding stated, is now endeavoring to establish a relation between the wind velocities as reported by the Weather Bureau and the velocities as exist in contact with building walls. Another problem the Laboratory is endeavoring to solve is the distance from the surface the wind velocity should be measured. Mr. Harding said that it is a comparatively simple matter to determine the conductivity factors, but the infiltration factors are more difficult to estimate.

Mr. Nicholls expressed doubt that it would be possible to prepare satisfactory data merely by observing wind velocities. It was his opinion that experiments should take condensation into consideration, observed under practical operating conditions.

In concluding the discussion, Professor Emswiler stated that the temperature in the room was held constant by thermostatic control, so that if the infiltration was increased and more cold air entered the building, it was compensated for by the thermostat. Professor Emswiler agreed with Mr. Segeler that it was important as to whether the calculations should be based on a single day of extreme conditions, or on a total of several hours in which the wind velocity was above a certain selected level. As to Professor

Larson's question, Professor Emswiler stated that there seemed to be no obvious relation between outside temperature and wind velocity, although with a lower temperature and the same wind velocity, the impact effect of the wind is greater.

Professor Emswiler stated that the measuring tube was arranged in such a way that it collected the dynamic pressure produced by the wind, and did not of itself result in any localized static pressure as the result of the wind blowing across it or at some angle to it. No measurements were taken of the quantity of air flowing through the gravity flues. Professor Emswiler stated that they merely took a record of the pressure differences as they existed in the two rooms, and that the gravity flues would readily account for the two pressure difference curves in relation to the wind. The author stated that although an extensive amount of laboratory work had been done in connection with the determination of the amount of infiltration that will take place through openings or cracks in windows and doors with certain specified pressure differences applying, it was his opinion that there was no rational way of deciding in the laboratory as to what wind velocity to use in making use of the tabular values resulting from the laboratory experiments.

H. M. Nobis asked if the recording gage contained a floating chamber or a diaphragm, and was informed that the gage operated on the principle of a hydrometer, that it floats at a certain level and that a very slight pressure will lift the gage considerably. The author stated that the only record required was the pressure difference across the window.

S. R. Lewis asked what had become of the Committee on the Effect of Atmospheric Conditions on Buildings, and was advised that the report of this committee would be included in the Research Department program.

The next paper was entitled Air Infiltration through Various Types of Brick Wall Construction, of which G. L. Larson, D. W. Nelson and C. Braatz were the authors. (Complete paper published in November 1929, A. S. H. V. E. JOURNAL.) The paper was presented by Professor Larson, who prefaced his remarks with a statement to the effect that he agreed with Mr. Nicholls there is a considerable amount of guessing to be done, but that this experimental work will permit more accurate guessing. The purpose of the paper was to establish definite relations between pressures on the two sides of a wall, and the leakage that takes place under these conditions. The experiments were started in 1927, and a preliminary report was submitted at a previous meeting.

After the presentation by Professor Larson, a written discussion by L. B. Lent was read by J. F. Vodges, Jr. In this discussion it was stated that experiments made in Germany some time ago indicated that the ratio of the infiltration through the brick and through the mortar, was about 1 to 380, and therefore the mortar joints are of far greater importance than the brick itself. He also stated that in his opinion the amount of moisture absorption by the brick had little or no significance so far as the amount of air which will pass through the brick is concerned, but that it may influence the adhesion of the bricks and mortar and therefore the tightness of the mortar joints. In the discussion by Mr. Lent, he also drew attention to the importance of plaster with respect to reducing infiltration, and pointed out that the cost of plastering should be much more than offset by the saving in the cost of heating equipment and the saving in the annual fuel bill.

Mr. Vodges stated that the *Common Brick Manufacturers Association* had conducted many tests relating to infiltration through brick walls, and that they had found it very difficult to duplicate conditions by taking the same materials and the same workmen and building two walls. Hence, there are many factors which enter into the problem of air leakage, and of these workmanship and kind of mortar are of great importance.

In a written discussion, E. C. Evans, stated that he had followed the investigations of Professor Larson and his colleagues since this work was started in 1927, and that the matter of wall leakage is of such vital importance to all human beings, that he hoped the Committee on Research would request a continuation of the work by Professor Larson. Mr. Evans emphasized the importance of reducing porosity, and called attention to the value of paint and plaster for this purpose. He also emphasized the desirability of discarding pent house design which, because of wall leakage, renders close temperature and humidity control almost impossible. He drew attention to the fact that soft acoutic plasters should be investigated in addition to gypsum plaster, and commented on the value of the results shown with respect to sealing the baseboard.

L. A. Harding questioned a statement made by Professor Larson to the effect that all brick walls should be plastered. He called attention to a single-story factory building having a large percentage of glass, stating that infiltration through the walls could take place only on the windward side of the building, and that since infiltration through walls is such a small percentage of the total heat loss of this type of building, it can be neglected.

Attention was directed to the matter of baseboard construction by F. D. Mensing, who referred particularly to the fire hazard resulting from the air travel from basement to upper stories. Mr. Nicholls questioned the advisability of furring because of the danger involved in the air space thereby created. E. K. Campbell stated that there is liable to be considerable difference between laboratory conditions and field conditions, and related an experience to indicate that very frequently in field conditions a situation is encountered that was not anticipated when the building was erected. H. M. Nobis suggested the advisability of covering wall surfaces with tin foil to aid in reducing infiltration losses. C. C. Hartpence told of using cement on the face of brick for the purpose of making it impervious to gas fumes. W. C. Randall said that in some of the larger buildings walls considerably less than 12 in. thick are being used; in fact in some cases, walls thinner than 8 in. are being

installed, and he suggested the need for investigation of walls of this type. S. R. Lewis suggested that chimneys in outside walls be not overlooked, and stated that fireplaces consistently have a backdraft.

In reply to questions asked by Mr. Evans, Professor Larson stated that the walls were not weighed and that they were allowed to stand for five months before the tests were conducted, and then check tests were run two months after the first test. No significant difference between the original test and the check test was apparent. Records of the wet and dry bulb readings were taken during all tests, but no effort was made to maintain a constant humidity. In fact, Professor Larson stated, no relation could be established between the results obtained and the wet and dry bulb readings.

As to the suggestion made regarding the conducting of tests at higher wind velocities, Professor Larson stated that they had no intention of going into this matter because it was previously suggested that it was not necessary to consider wind velocities above 25 miles per hour. Professor Larson agreed to consider the suggestion relative to pent houses and also that relating to methods of treating the walls. He declared that a considerable amount of information as to how walls should be painted may be brought to light, and stated that the committee would also be glad to consider the effect of removing the paint from the wall surface. He agreed that the suggestion made by Mr. Cassell relative to waterproofing the walls was a good one and hoped that the investigation would permit of a study of this phase of the subject. President Lewis called attention to the fact that this paper was the result of co-operative research.

# Third Session—Wednesday, January 29—9:30 A. M.

The fore part of this session was devoted to the work of the Research Department. The report of the Committee on Research was given by the Chairman, L. A. Harding. He advised that at the last meeting the matter of rules and regulations for the operation of the Research Committee were discussed, and a committee was appointed for the purpose of putting the rules and regulations in proper form for presentation to this meeting for adoption. Mr. Harding pointed out that the committee had been operating under the original rules of the laboratory, and that from time to time additional rules and regulations have been passed, whereas others have been rescinded or amended until the governing statutes were now in a very unsatisfactory condition. Mr. Harding stated that the revised rules and regulations would be presented later, but that there were one or two items which should bear close scrutiny because of the fact that fundamental changes in policy are involved.

The announcement regarding the appointment of T. J. Duffield as Executive Secretary of the Committee on Research, was made by Mr. Harding, after he had explained the difficulties encountered by the Chairman of the Committee on Research in attending to his own business affairs and performing the duties in connection with the Chairmanship of the Committee.

## Report of Committee on Research

Four meetings of the Committee on Research were held during the past year. At the first meeting in Chicago during the last annual meeting of the Society, plans for the work of the year were discussed.

Seven members of the Committee attended a meeting in Pittsburgh during the time of the Open House at the Research Laboratory, November 4, 1929. The work of the several technical advisory committees and the work carried on at the Society's Laboratory and in the cooperating university laboratories was discussed and plans perfected for the future.

A third meeting of the Committee in Buffalo on December 20 was attended by 11 members. A number of matters of vital importance to the future progress of the Laboratory were discussed at this meeting. A committee made up of D. S. Boyden, Chairman, Philip Drinker, R. S. Franklin, and assisted by W. T. Jones was appointed to revise and bring up-to-date the regulations for the guidance of the Committee on Research in the operation of the Research Laboratory. The proposed regulations after approval by the Council to be presented to the Society at the annual meeting for adoption.

It was decided at this meeting that the Research Laboratory should engage in research and testing for associations and also for individuals and firms or corporations under certain restrictions as provided by the new regulations, who wish to finance the work involved. In this connection, it was agreed that the Laboratory would, when requested, carry on certain research and testing desired by the *Heating and Piping Contractors National Association.*

It was also decided at the Buffalo meeting of the Committee to recommend to the Council of the Society the appointment of a full-time paid executive secretary to the Research Committee in order to relieve the chairman of many of the routine burdens of his office and to make a more concerted effort to obtain funds for the research activity of the Society and give more effective publicity to the work of the Laboratory.

This Laboratory has 12 research projects under investigation or under consideration for investigation. The work on these problems is outlined by the following technical advisory committees:

*Temperature, Humidity and Air Motion:* W. H. Carrier, *Chairman;* O. W. Armspach, S. C. Bloom, C. A. Bulkeley, Philip Drinker, W. A. Rowe, Perry West.

*Infiltration:* G. L. Larson, *Chairman;* A. W. King, A. P. Kratz, L. B. Lent, W. C. Randall.

*Heat Transmission:* A. P. Kratz, *Chairman;* D. R. Brewster, F. B. Rowley, C. G. Segeler, Perry West.

*Pipe Sizes for Heating Systems:* H. M. Hart, *Chairman;* S. E. Dibble, R. S. Franklin, F. E. Giesecke, C. V. Haynes, R. C. Morgan.

*Heating and Ventilation in Its Relation to Health and Comfort:* Philip Drinker, *Chairman;* John Aeberly, O. W. Armspach, C. P. Yaglou.

*Radiation:* R. A. Wolff, *Chairman;* C. W. Brabbée, R. V. Frost, A. C. Willard, C. H. B. Hotchkiss, J. F. McIntire, F. D. Mensing.

*Garage Ventilation:* E. K. Campbell, *Chairman;* W. H. Carrier, E. B. Langenberg, Thornton Lewis.

*Air Cleaning Devices:* F. B. Rowley, *Chairman;* H. E. Birkholz, Albert Buenger, E. V. Hill, H. C. Murphy.

*Atmospheric Dust and Smoke:* E. B. Langenberg, *Chairman;* E. V. Hill, S. R. Lewis, H. C. Murphy.

*Oil Burning Devices:* L. E. Seeley, *Chairman;* James Breese, Jr., G. S. Meikle, H. L. Tapp.

*Effect of Wind and Weather Conditions on the Heating Loads:* R. S. Franklin, *Chairman;* W. L. Fleisher, J. F. Hale, E. B. Langenberg, S. R. Lewis, F. R. Still, A. C. Willard.

*Testing and Rating Unit Heaters:* D. E. French, *Chairman;* O. K. Dyer, G. E. Otis, H. W. Page, W. A. Rowe, J. H. Schrock, L. C. Soule.

Annual reports of the Technical Advisory Committees submitted to the Chairman of the Committee on Research are appended.

A large part of the work of the Laboratory is now carried on

in ten universities and colleges in accordance with contracts or cooperative agreements. The institutions cooperating with the Laboratory during the past year and the projects on which they worked are as follows:

*Armour Institute of Technology*—Measurement of air flow through registers and grilles.

*Carnegie Institute of Technology*—Pipe sizes for steam heating.

*Harvard University*—Vital characteristics of the atmosphere.

*University of Kentucky*—Study of methods of testing unit heaters.

*University of Minnesota*—Heat transmission through building contruction; and the efficiency of air cleaning devices.

*Purdue University*—Standardization of method of testing radiators.

*Agricultural and Mechanical College of Texas*—Pipe sizes for hot water heating.

*Washington University*—Garage ventilation in relation to carbon monoxide and fire hazards.

*Wisconsin University*—The air leakage through walls.

*Yale University*—Standardization of methods of testing oil burners.

In each of these institutions with the exception of Carnegie Institute of Technology, the research is under the supervision of the university which furnishes all overhead for the work in addition to one-half of the salaries of the investigators carrying on the work.

Carnegie Institute of Technology cooperates to the extent of furnishing laboratory space, heat, power and other facilities for the pipe size investigation which is carried on by the Research Laboratory staff.

Besides the pipe size study which is carried on at Carnegie Institute of Technology, the Laboratory staff is working on the following problems at the Research Laboratory in the Pittsburgh Experiment Station of the U. S. Bureau of Mines: Heat and moisture losses from the human body and their relation to air conditioning problems. Air leakage through a stucco and a hollow tile brick veneer wall. Change in the conductivity of concrete with time. The absorption of solar radiation by a wall or roof.

During the past year the study of heat loss through walls with the Nicholls heat flow meter was discontinued and another phase of the heat transmission problem was taken up—namely, the study of surface transfer coefficients for various types of surfaces met with in building construction. In order to better understand heat transfer for these surface conditions a study was also undertaken of wind velocity gradients near a wall. The velocity gradients for a wind parallel to the wall surfaces has been completed. Apparatus for measuring the surface heat transfer was constructed and some data on the subject collected.

As a result of the work carried on by the Research Laboratory ten papers were presented to the Society during the year—five at the last summer meeting and five at the present annual meeting:

Capacity of Radiator Supply Branches for One and Two-Pipe Systems, by F. C. Houghten, M. E. O'Connell and Carl Gutberlet.

Determining Dust Quantities in Air by Prof. F. B. Rowley and John Beal.

Heat and Air Volume Output of Unit Heaters, by L. S. O'Bannon.

Over-all Heat Transmission Coefficients as Determined by Test and by Calculation, by F. B. Rowley, A. B. Algren and J. L. Blackshaw.

Pipe Sizes for Hot Water Heating Systems, by Prof. F. E. Giesecke and E. G. Smith.

Absorption of Solar Radiation in Its Relation to the Temperature, Color, Angle, and other Characteristics of the Absorbing Surface, by F. C. Houghten and Carl Gutberlet.

Air Infiltration Through Various Types of Brick Wall Construction, by G. L. Larson, D. W. Nelson and C. Braatz.

Measurement of the Flow of Air Through Registers and Grilles, by L. S. O'Bannon.

Pipe Sizes for Hot Water Heating Systems, by Elmer Smith.

Surface Transmission Coefficients, by F. B. Rowley, A. B. Algren and J. L. Blackshaw.

The results of the Laboratory's study of relation of atmospheric condition to physiological reactions of man are of great interest to the medical and physiological profession and the results of the Laboratory's study of heat and moisture loss from adults at rest were published in the April, 1929, *American Journal of Physiology*. A second paper on heat and moisture loss from men working has since been submitted for publication.

Besides the results published during the year, the Laboratory has data on air leakage through walls, change of conductivity of concrete with time, and the capacity of pipe for the returns of steam heating systems.

The finances of the Laboratory are in good shape. Receipts for the year were slightly greater than expenditures so that a little was again added to the surplus. Subscriptions are reported as follows:

## Contributions to the A. S. H. V. E. Research Fund in 1929

| *Name* | *Amount* |
|---|---|
| Aerofin Corp. | $ 100.00 |
| Air Filter Association | 600.00 |
| American Blower Co. | 1,000.00 |
| American District Steam Co. | 200.00 |
| American Steam Pump Co. | 50.00 |
| Armstrong Cork and Ins. Co. | 150.00 |
| Barnes and Jones | 200.00 |
| Bishop and Babcock Sales Co. | 50.00 |
| Blaney, Chas. A. | 100.00 |
| Buffalo Forge Co. | 250.00 |
| Carrier Engineering Corp. | 300.00 |
| Celotex Co. | 100.00 |
| Engineering Publications, Inc. | 100.00 |
| C. A. Dunham Co. | 600.00 |
| Heating-Piping Contractors Nat. Assn. | 500.00 |
| Hoffman Specialty Co. | 250.00 |
| Ilg Electric Ventilating Co. | 200.00 |
| Illinois Engineering Co. | 300.00 |
| Johnson Service Co. | 500.00 |
| Kewanee Boiler Co. | 250.00 |
| McAlear Mfg. Co. | 300.00 |
| Modine Mfg. Co. | 200.00 |
| Nash Engineering Co. | 335.00 |
| National Lumber Mfg. Assn. | 322.87 |
| National Regulator Co. | 250.00 |
| Nesbit, John J., Co. | 250.00 |
| N. Y. Blower Co. | 150.00 |
| Ontario Chapter | 132.00 |
| Phila. Chapter | 100.00 |
| Powers Regulator Co. | 200.00 |
| B. F. Sturtevant Company | 750.00 |
| Taylor Instrument Co. | 50.00 |
| Trane Co. | 200.00 |
| U. S. Gypsum Co. | 50.00 |
| Ventilating Contractors Employers Assn. of Chicago | 400.00 |
| Walworth Co. | 100.00 |
| Warren Webster & Co. | 1,000.00 |
| York Heating and Ventilating Corp. | 400.00 |

## Report of the Technical Advisory Committee on Air Cleaning Devices

December 17, 1929

The Committee has held two meetings, one at the time of the annual meeting in Chicago and the other on December 11 in Chicago. At the first meeting, plans for research at the University of Minnesota were discussed, and it was decided to continue the study of the problem of determining the dust in air. Accordingly, the work which had been previously started with the A. A. Dust Determinator was completed and further series of tests were made with the Hill Dust Counter.

A report of the study made on the Hill Dust Counter was given at the semi-annual meeting, in a paper entitled, An Investigation of the Impingement Method of Determining the Quantity of Dust in Air. This paper was published in the A. S. H. V. E. Journal, June, 1929, Volume 35, Number 6.

As a result of the study of the Hill Dust Counter, it was found that this Counter had one or two defects which it appeared could be easily overcome. Those defects which were causing irregularities in the results were:

1. The fact that the air velocity through the nozzle was not constant, due to the pressure created by the stroke of the pump.
2. It was found very necessary that the distance from the orifice to the glass plate be maintained exactly the same in all counters.
3. The size of the orifice affected the dust counter.
4. In order to get uniform results after the sample was taken,

it was essential to place the sample under the microscope in exactly the same position and to use a microscope which was easily focused.

These changes have been discussed with Dr. Hill who is now building a new instrument which will be tried out in the laboratory.

At the meeting in Chicago on December 11 the Committee reviewed the research work and considered a request from the Technical Advisory Committee on Atmospheric Dust and Smoke to recommend changes in the Hill Counter which would insure more uniform results by different operators. As these changes were along the line of those suggested by previous research work, Dr. Hill agreed to make up a counter embodying them and send it to the laboratory for test.

The research work in connection with the Committee will be mostly with the Hill Dust Counter until the annual meeting at which time further plans will be considered.

F. B. Rowley, *Chairman;* H. E. Birkholz, Albert Buenger, E. V. Hill, H. C. Murphy.

## Report of the Technical Advisory Committee on Testing and Rating Unit Heaters

December 19, 1929

The Unit Heater Committee planned no work during 1929, other than that done at the University of Kentucky in cooperation with the Research Laboratory of the Society, in the interest of the code for testing and rating unit heaters, and which I understand will be covered by Mr. Houghten's report on the subject.

The desirability of further work at the University of Kentucky in cooperation with the Research Laboratory in the general interest of the Unit Heater field, was discussed. A number of topics were considered, such as

(a) A formula for converting unit heater ratings at one condition of entering air temperature and steam pressure to some other condition which would properly account for change in mass velocity and which might simplify the present code method.

(b) The desirability and adaptability to all types of heaters of the method of testing at a single fan speed but against varied resistances, by comparison with the method of testing at varied fan speeds in order to determine characteristic curves.

(c) Proof that the assumption that heat transfer from the coil for a given mass velocity of the air is proportional to the mean temperature difference between the entering air and steam pressure that holds for all coil materials and lengths of fin and character of the fin and the prime surface.

When these were referred to Professor O'Bannon with the request for an outline of tests and appropriation estimate, he felt in each case either that there was so little hope of a satisfactory solution or so little value in developing more information than was already on record, that the University of Kentucky could not recommend an appropriation.

Other work of a more routine nature, needed to confirm some of the assumptions of the Code, could be more quickly undertaken by one of the member companies, and so was not referred to the Research Laboratory.

At the last meeting of the Engineering Committee of the *Industrial Unit Heater Association,* which is composed of a representative from each of the member companies of the Association, I asked for suggestions on research work of value to the industry which might be referred to the Research Laboratory. As yet no suggestions have been forthcoming.

D. E. French, *Chairman;* O. K. Dyer, G. E. Otis, H. W. Page, W. A. Rowe, J. H. Schrock and L. C. Soule.

## Report of the Technical Advisory Committee on Heat Transmission

December 12, 1929

A meeting of the committee was held June 27, 1929, at Big-win Inn, Canada, at which time a program of tests was agreed upon, both for the Laboratory and for Professor Rowley's work at Minnesota.

The following papers have been prepared for presentation during the past year:

1. Overall Heat Transmission Coefficients as Determined by Tests and by Calculations, by F. B. Rowley, A. B. Algren and J. L. Blackshaw. Presented at the Spring Meeting, June 28, 1929.

2. Effects of Air Velocities on Surface Coefficients, by F. B. Rowley, A. B. Algren and J. L. Blackshaw. To be presented at the Annual Meeting, January 27-31, 1930.

3. Absorption of Solar Radiation in Its Relation to the Temperature, Color, Angle and Other Characteristics of the Absorbing Surface, by F. C. Houghten and Carl Gutberlet. To be presented at the Annual Meeting, January 27-31, 1930.

The work has progressed following the outline adopted at the meeting of the committee of June 27. The present status can best be shown by extracts from the reports of Professor Rowley and Mr. Houghten.

The work in progress for the present year consists of hot box and hot plate tests. For the hot box test, the following schedule of walls is under way:

(a) Two rubble walls constructed 10 inches in thickness, of Blue Trenton Limestone. This material runs about 4-5 inches in thickness and will be selected in suitable widths for 10-inch walls.

(b) Six concrete block walls; two 6 in. thick, two 8 in. thick, and two 10 in. thick; the size of the blocks to be 7¾ inches in height, 15¾ inches in length, and of three-cell construction. Two types of blocks will be used: the first in which crushed limestone is used for the aggregate, and the second in which limestone is not used. These blocks will be selected from two representative block manufacturers in Minneapolis.

(c) Two concrete walls with 1-2-3½ mix with aggregate ranging from 1 inch down, one wall to be constructed with a 3-inch slump and the other with a 6-inch slump. These walls are to be poured in a vertical position in two lifts.

The hot plate tests will be as follows:

(a) Specimens 1-2-3½ mix with 3-in., 5-in. and 7-in. slump.
(b) One 1-3-5 mix with 5-in. slump.
(c) One 1-4-6 mix with 5-in. slump.
(d) One 1-1½-2½ mix with 5-in. slump.
(e) Two gypsum plaster panels.
(f) Two cement plaster panels.

These tests will be made on the 24-in. hot plate with specimens 2 inches in thickness. The concrete panels will be compared with the results as obtained by the hot box method.

The work originally outlined for determining wind velocity gradients parallel to a wall has been completed and a complete report of the work was prepared. It has appeared desirable, however, to hold up this report pending completion of the work on determination of surface coefficients of heat transfer for still and moving air.

Apparatus for the method of determining surface transmission coefficients for still and moving air as outlined by Mr. Harding has been constructed and a set of data giving a curve showing the relationship between the surface transmission coefficient and wind velocity has been completed for a neutral gray painted surface at a temperature of 90 deg. with air at 70 deg., giving a 20 deg. temperature difference. This work shows coefficients considerably higher than previously accepted for both still and moving air. Air velocities from a little above one mile to 23 miles per hour have been studied. This work is just now interrupted while the temperature and heat control apparatus is being used in the calibration of several Nicholls Heat Flow meters. As soon as the apparatus is again available—probably in about three weeks—it is our intention to develop a like curve showing the relationship of the surface transmission coefficient for the same surface and wind velocity for another temperature range. At the present time we are figuring on a temperature range of

from 50 to 70 deg. If, however, a preliminary study shows that we can get a lower temperature it is our intention to use a temperature degree difference of 20 deg. with as low an air temperature as we can depend on getting in our apparatus and reasonable percentage of the time.

We are continuing the tests on conductivity of the concrete slab which has been under investigation for the past two or more years. The conductivity shows little or no change. However, it will probably take another six months to insure that no change is taking place.

The status of the future program is as follows:

Further hot plate tests will be made on the various types of insulating materials in accordance with the program of June 27. These insulating materials are at present being selected by Mr. Houghten and Mr. Close.

An exhibit covering the heat transmission work is to be prepared for the Heating and Ventilating Show at Philadelphia. This exhibit will consist of a complete set-up of the hot plate apparatus and will occupy a part of the Research Laboratory space.

Further papers which are planned in this field will be a completion of the surface coefficients research work, and more complete results on hollow block, concrete, and tile walls. These papers will probably be ready by next spring.

A part of this work which I believe it is now safe to report is the cooperative work between the *National Lumber Manufacturers' Association*, the Heating and Ventilating Society, and the University of Minnesota. The *National Lumber Manufacturers' Association* has already contributed to the University for this work a sufficient amount to make about half of the tests. They are now planning on a further contribution to the University and the Society, which I believe will work out satisfactorily.

Some studies for the purpose of correlating Weather Bureau readings with arbitrarily measured velocities over actual wall surfaces is under consideration, but has not been definitely approved by the committee as yet. This will form the basis for further thought and discussion on the part of the committee.

A. P. Kratz, *Chairman;* D. R. Brewster, F. B. Rowley, C. G. Segeler, Perry West.

## Report of the Technical Advisory Committee on Infiltration

January 7, 1930

The activities of the Committee on Infiltration can be best illustrated by the two papers relating to Infiltration which will be presented by members of the Committee at the coming meeting in Philadelphia.

I refer to the papers Pressure Difference Across Windows in Relation to Wind Velocity, by J. E. Emswiler and W. C. Randall and Air Infiltration Through Various Types of Brick Wall Construction, by G. L. Larson, D. W. Nelson and C. Braatz.

The work by Emswiler and Randall ties in very well with the Laboratory work on infiltration that we have been doing here.

I think our laboratory work has established quite definitely the amount of infiltration that can be expected under certain definite wind conditions in relation to brick walls, and the paper by Emswiler and Randall is a start on the actual wind conditions that may be expected in practice.

In other words, I might say that the work under the guidance of the Committee on Infiltration during the past year has established the following facts:

1. In a reasonably well constructed brick wall the air leakage is very small compared with the heat transmission.
2. Proper application of plaster either direct or on furring eliminates practically all leakage.
3. Leakage in walls is caused by faulty construction and may be anything depending on how poor the construction is.
4. The Emswiler and Randall paper has established the pressure difference across windows that may be expected in comparatively low buildings.

The work planned by the committee for the future is as follows:

1. Study of several frame walls at the University of Wisconsin.
2. Study of 1 stucco and 1 hollow tile brick veneer wall at the Research Laboratory in Pittsburgh.

The paper on brick wall construction concludes for the present at least, research work on that type of construction. Research is under way on frame wall construction and we plan to present a paper on infiltration through frame walls at the summer meeting in June.

The Committee is asking Emswiler and Randall to continue their work on pressure differences across windows with particular reference to tall buildings.

It has also been suggested that the Committee encourage further work on weather-strip research.

G. L. Larson, *Chairman;* A. W. King, A. P. Kratz, L. B. Lent, W. C. Randall.

## Report of Committee on Heating and Ventilation and Its Relation to Health and Comfort

December 16, 1929

The primary purpose of this committee is to study the difference between indoor and outdoor conditions, particularly the difference between an artificial indoor condition and the natural outdoor conditon which it is intended to reproduce.

The first step in the study will be the observation of the degree of ionization in different atmospheres, natural and artificial. The major part of this experimental work will be carried out at the Harvard School of Public Health by means of a special instrument imported from Germany. Through the Research Laboratory of the American Society of Heating and Ventilating Engineers, the experimenters have been granted funds to defray the cost of this equipment. On account of irksome delays on the part of the German manufacturer and the necessity of replacements due to breakage en route, the apparatus is only now ready for use. We therefore can submit no data at this time.

If this preliminary research gives significant results, the logical sequel would be a study of methods and equipment to produce the desired conditions indoors.

Philip Drinker, *Chairman;* John Aeberly, O. W. Armspach and C. P. Yaglou.

## Report of Technical Advisory Committee on Oil Burning Devices

December 30, 1929

The oil burning research program is conducted by Professor L. E. Seeley at Mason Laboratory, Sheffield Scientific School, Yale University, in co-operation with the Research Laboratory, and the *American Oil Burner Association.*

The work on oil burners was actively started about the first of October. The work to date has consisted of installing four types of small heating boilers so that complete tests might be run on any two boilers at the same time.

The oil burners are in the process of installation at the present time. There are five types of oil burners to be operated. It is the intention to rotate these burners so that each one will be operated in each boiler.

The above equipment as well as draft regulating devices and oil supply equipment has been obtained "on consignment" through the efforts of Mr. Harry Tapp of the *American Oil Burner Association.*

The primary object of the tests which will start actively within two weeks is to develop a code for testing a combination of boiler and oil burner. This code will be developed and the tests shown as evidence to support our recommendations.

It is expected that many smaller investigations will develop, some of which may accompany the main report to be submitted in June, 1930. Certain incidental findings may be transmitted directly to Mr. Tapp who will co-operate with the respective burner companies if it seems warranted.

The appropriation for this year is not used up and it is our intention to use the remainder during the coming months. Nego-

tiations for further appropriations will be submitted at a future date. It is our belief that we shall know more about the costs of conducting tests and that better expense estimates can be made. Our costs to date have been on installation which is in the nature of a base expense only.

It has also been agreed that the mechanical engineering department of Yale University will furnish a few pictures and examples of the work done here along the lines of heating for the Exposition in Philadelphia during January.

L. E. Seeley, *Chairman;* James Breese, Jr., G. S. Meikle and H. L. Tapp.

## Appendix
## Regulations Governing the Research Committee of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

(Presented for adoption by the American Society of Heating and Ventilating Engineers)

JANUARY, 1930

### Function

The function of the Research Committee is the determination and dissemination of engineering knowledge pertaining to the art of heating and ventilating and the equipment and apparatus utilized by the profession.

### Purpose

The purpose of the Research Committee is to supervise the investigation, collection, tabulation and co-ordination of existing data and records of subjects pertaining to the art of heating and ventilating, and when the need is sufficient to warrant research or testing, to devise a plan for such procedure; also the establishment and maintenance of a Research Laboratory, and the negotiation with universities, colleges, and other organizations provided with laboratories for co-operative research and testing work.

### Section I
### Organization

*Research Committee*

1. There shall be a standing committee known as the Research Committee, consisting of fifteen members each serving for three years, and five retiring each year.
   (a) The Council shall nominate previous to October first of each year five members to fill the vacancies of those retiring at the next annual meeting.
   (b) The nominations made by the Council shall be published in the October issue of the SOCIETY's Journal.
   (c) Prior to December first of any year, any ten members over their own signatures, may nominate one or more additional members of the Research Committee, and such additional nominations shall be placed on the ballot opposite the nominations made by the Council.
   (d) The election shall otherwise conform to the regulations provided for the election of officers of the SOCIETY.
   (e) Vacancies may be filled by the Council, such persons chosen by the Council to serve until a successor is elected at the next Annual Meeting.

*Executive Committee*

2. There shall be an Executive Committee consisting of the Chairman and two other members of the Research Committee appointed by him immediately following the Annual Meeting.

*Technical Advisory Committees*

3. The Chairman of the Research Committee shall appoint such Technical Advisory Committees and designate a Chairman of each, as the Executive Committee may deem advisable, to act in an advisory capacity to the Research Committee and the Director of the Research Laboratory for specific projects or tests under consideration. At least one member of each Technical Advisory Committee shall be a member of the Research Committee. The Director of the Laboratory shall be an ex-officio member of all Technical Advisory Committees.

*Chairman Research Committee*

4. The Research Committee shall at its meeting held at the time and place of the Annual Meeting of the SOCIETY each year elect by ballot vote one of their number to serve as Chairman for the ensuing year.

*Vice Chairman*

5. A Vice Chairman shall also be elected in the same manner and for the same period as stated for the Chairman in the preceding paragraph.

*Meetings of Research Committee*

6. A meeting of the Research Committee shall be held at the time and place of each Annual and Semi-Annual Meeting of the SOCIETY. Special meetings may be called at the discretion of the Chairman, or by a majority vote of the Executive Committee. The place and date of the special meeting to be designated by the Chairman.

*Quorum*

7. Seven members of the Research Committee shall constitute a quorum.

### Section II
### Duties of Committees

*Research Committee*

1. The Chairman of the Research Committee shall preside at all meetings of the Research Committee and the Executive Committee. The Chairman of the Research Committee shall be an ex-officio member of all Technical Advisory Committees.
2. The Vice Chairman shall possess all the powers and perform the duties of the Chairman in his absence.
3. All acts of the Research Committee other than those specifically authorized shall be subject to review by the Council.
4. All acts, findings or reports of sub-committees shall be subject to the approval of the Research Committee.
5. The reports of all investigations conducted at the SOCIETY's Research Laboratory or resulting from co-operative agreements shall be made available to all members of the SOCIETY through publication in the Journal when authorized for publication by the Research Committee and approved by the Publication Committee.
6. All papers, findings or reports resulting from the work of the Research Committee shall when published by the SOCIETY be headed by a picture of the Laboratory at Pittsburgh, Pa.
   (a) If the paper, finding or report is the result of work at the Pittsburgh Laboratory, the following statement shall directly follow the picture: "Research conducted by the Research Laboratory of the American Society of Heating and Ventilating Engineers in co-operation with the U. S. Bureau of Mines."
   (b) If the paper, finding or report is the result of co-operative work with some other institution or laboratory, the following statement with the approval of the Director of the United States Bureau of Mines shall directly follow the picture: "Research conducted at (name of co-operating institution or laboratory of the American Society of Heating and Ventilating Engineers.
7. "Constitution and By-Laws; Article IX; Special Committees: Section 1. The Research Executive Committee, as provided for under the regulations creating the Research Laboratory, shall prepare the budget for the expenditures of the Research Laboratory for the current year, and shall pass upon and approve in writing all expenditures authorized by the Research Committee. The payment of bills shall be authorized in the same manner as provided in Article VIII, Section 3, excepting that the Chairman of the Research Executive Committee shall act instead of the Chairman of the Finance Committee, and the Director of the Research Laboratory shall act instead of the Secretary of the SOCIETY, but in case of absence or disability on the part of the Treasurer the checks may be signed by the Chairman of the Research Committee instead of the Chairman of the Finance Committee."

*Executive Committee*

8. The Executive Committee shall supervise all the business of the Research Committee including the making of the necessary contracts for rental or purchase of equipment or materials. This Committee shall select and engage a Director of the Research Laboratory, an Executive Secretary to the Research Committee, and such assistants of the Research Laboratory as may be required, or the authority for the selection and employment of such assistants may be delegated to the Director of the Laboratory by authority of the Executive Committee in individual cases. The Committee shall determine all salaries, approve all expenses incurred, and determine the order in which the subjects shall be investigated by the Research Laboratory.
9. The Executive Committee shall not make contracts in excess of the income of the Research Committee without the approval of the Research Committee.

*Technical Advisory Committees*

10. Technical Advisory Committees shall act in an advisory capacity to the Research Committee and the Director of the Laboratory on all subjects referred to them.
    (a) The Chairman of a Technical Advisory Committee shall be responsible for obtaining the opinion and advice from each member of his Committee concerning the assigned subject. The advice on the assigned subject as to the methods of procedure, etc., shall be transmitted to the Chairman of the Research Committee.
    (b) In the case of a new Committee this advice shall be furnished as promptly as conditions shall warrant in order that there shall be no unnecessary delay in starting the investigations.
    (c) Each Committee shall submit its recommendations in writing to the Research Committee and render annually, not later than December first of each year, a written report of its activities.

### Section III
### Regulations

1. That any research may be undertaken for other engineering, scientific, technical organizations, trade associations, manufacturers' associations, persons, firms, or corporations provided all work shall be related to the art or science of heating and ventilating and of such character as to meet with the approval of the Research Committee, and that only those subjects may be investigated for which sufficient funds to pay all costs thereof have been assured.

2. That any testing of apparatus may with the written approval of the manufacturer be undertaken upon application by any engineering, scientific, technical organization, trade association, or manufacturers' association, upon request.
3. When any test of apparatus has been or is being made in accordance with the preceding paragraph, then any person, firm or corporation may have similar apparatus of his manufacture tested upon application.
4. All tests shall be conducted under the following conditions.
   (a) That the Research Committee shall sanction each test before being made and approve the testing procedure to be used.
   (b) That the applicant shall pay all costs to the Laboratory such as: the salaries of investigators, materials, supplies, labor, expenses, and overhead.
   (c) That the applicant shall keep on deposit with the Treasurer of the Society an amount equal to the estimated cost of the work for not less than two months in advance, against which amount the costs shall be charged.
   (d) The applicant shall be advised of the progress of the test and shall have the privilege of discontinuing at any time upon giving written notice, and the paying of all costs including salaries of the investigators to the end of the month following such notice.
   (e) The result of the test without comment may be authorized for publication in the JOURNAL by mutual consent of the applicant and the Research Committee.
   (f) That the applicant shall not publish or allow to be published in whole or in part the report of the test until after publication in the JOURNAL of the Society, or by authority of the Research Committee.
   (g) That the apparatus tested shall be removed from the Laboratory by the applicant promptly upon the completion of the test.
   (h) That the applicant shall give a bond or other security approved by the Research Executive Committee guaranteeing to the Society the full performance of the contract on the part of the applicant.

*Committee:* D. S. Boyden, *Chairman,* R. S. Franklin, Philip Drinker.
*January* 24, 1930.

*Research Laboratory of the American Society of Heating & Ventilating Engineers, 29 West 39th St., New York City.*

Gentlemen:

As requested I audited the books of account and records of the Research Laboratory of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Pittsburgh, Pa., for the year ended December 31, 1929, and submit herewith my report.

The recorded Cash Receipts for the year previously stated were traced into the banks, also the cancelled checks and duly approved disbursement vouchers were checked against the cash book.

A verification of the Cash on Deposit was obtained by communicating directly with the depositories and reconcilement of the amounts reported to the balances reflected by the books of account.

Respectfully submitted,

*Frank G. Tusa,*
Certified Public Accountant.

CASH RECEIPTS AND DISBURSEMENTS

RESEARCH LABORATORY OF THE AMERCIAN SOCIETY OF HEATING AND VENTILATING ENGINEERS—PITTSBURGH, PA.

FOR THE YEAR ENDED DECEMBER 31, 1929

| | | | |
|---|---|---|---|
| BALANCE—DECEMBER 31, 1928, PER FORMER REPORT | | | $ 4,910.03 |
| RECEIPTS | | | |
| From the American Society of Heating and Ventilating Engineers | $23,168.67 | | |
| Other Contributions | 10,257.87 | $33,426.54 | |
| Interest on Bank Balances | | 110.05 | 33,536.59 |
| | | | 38,446.62 |
| DISBURSEMENTS | | | |
| Salaries—Per Schedule | | 23,141.32 | |
| Traveling—F. C. Houghten | 1,663.95 | | |
| Traveling—Staff | 260.26 | | |
| Traveling—Executive Committee | 226.50 | 2,150.71 | |
| Laboratory Equipment and Supplies | | 1,836.74 | |
| University Cooperation | | 5,812.30 | |
| OFFICE EXPENDITURES | | | |
| Telephone and Telegraph | 126.61 | | |
| Postage | 152.28 | | |
| Professional Services | 100.00 | | |
| Expressage | 79.24 | | |
| Photostats | 74.66 | | |
| Stenography Service | 57.00 | | |
| Meeting Expense | 50.30 | | |
| Furniture and Fixtures | 49.27 | | |
| Printing and Stationery | 27.25 | | |
| Miscellaneous | 25.47 | 742.08 | 33,683.15 |
| BALANCE—DECEMBER 31, 1929 | | | $ 4,763.47 |

DISPOSITION OF FUNDS

| | | |
|---|---|---|
| AT NEW YORK, N. Y. | | |
| BANKERS TRUST COMPANY | | |
| Cash on Deposit | $ 1,680.54 | |
| Securities — 3M General American Tank Car Copr. Bonds (Market Value $2,910.00) | 3,045.61 | $ 4,726.15 |
| AT PITTSBURGH, PA. | | |
| OAKLAND SAVINGS AND TRUST COMPANY | | |
| Cash on Deposit | 20.23 | |
| PETTY CASH FUND | 17.09 | 37.32 |
| | | $ 4,763.47 |

The next report was that of the Research Laboratory, submitted by Director F. C. Houghten. He called attention to the rapid progress which has been made in the heating and ventilating art, particularly in the past ten years. He cited THE GUIDE as a striking example of the progress that has been made, and drew attention to the fact that the results of the experimental work done at the laboratory are found throughout this book.

Mr. Houghten pointed out the wide acceptance that has been given the results obtained by the Laboratory, and then outlined the projects now being investigated, as well as those completed and those for future consideration. The projects touched upon by Mr. Houghten, included the general study of the relation of man to his atmospheric environment, the pipe size investigation, garage ventilation, heat transmission experiments, dust determinations in various cities, and oil burner studies.

J. C. Fitts, chairman of the *Association for Correlating Thermal Research,* in a report of its work explained the purpose of the association, and told of the progress that had been made since it was organized in 1927. He stated that the membership had not been increased since the association was established, and that little effort had been made to increase it, but that the service rendered has been very materially increased. The association now has 13,000 cards on file in Pittsburgh from which information can be obtained by writing to the librarian, Mrs. Houghten, regarding books and articles on subjects relating to heating. Complete information regarding thermal research can also be obtained from this organization, and it is believed that the organization is doing a splendid service by eliminating waste and duplication of effort.

President Lewis called on Past-Presidents H. M. Hart and R. P. Bolton, and Mr. Bolton said that it was a source of great satisfaction to witness the wonderful growth of the SOCIETY as evidenced by the attendance at the meeting and the registration. He recalled the

struggles of the early organization and pointed out the handicaps with which they had to contend. Henry B. Gombers, Secy. of the H. & P. C. N. A., reiterated the difficulties encountered in the early days of the SOCIETY, and expressed his loyalty to the organization.

The next item of business was the presentation of the Report of the Committee on the Revision of the Regulations Governing the Research Laboratory, which was made by D. S. Boyden. (See Appendix to Report of Committee on Research.) After a brief discussion of the proposed changes by Mr. Boyden, it was moved and seconded that the recommendations of the committee be accepted.

The subject of commercial testing was the source of considerable debate, and Dr. E. V. Hill questioned the advisability of our Laboratory entering into work of this nature. President Lewis called attention to the fact that according to the regulations of the laboratory established in 1924, the Research Laboratory was permitted to undertake commercial testing with the approval of the Committee on Research.

Dr. Hill questioned the proposed regulation necessitating the approval by the Publication Committee of Research Laboratory data before it is published in the JOURNAL. He felt that one of the serious handicaps of the laboratory in the past has been lack of publicity, and was of the opinion that this proposed step would render a further handicap.

With regard to commercial testing, Mr. Mensing stated that the interest of the SOCIETY was safeguarded by the fact that research was run by brains and not by resolutions, and as to publicity, he felt that the retention of the Executive Secretary would fill this void.

Professor Dibble cautioned against the possibility of our connection with the U. S. Bureau of Mines being severed if commercial testing is undertaken, and also raised the question as to whether or not the future administrations would be agreeable to projects sanctioned by the present administration.

Mr. Harding answered this question by stating that no commercial testing is permitted in the laboratory at Pittsburgh, and that all work of this nature would of necessity be done in other laboratories. He expressed the opinion that these tests would not become a part of the TRANSACTIONS excepting in a few instances where some particular type of apparatus was tested and in which the members were vitally interested. He agreed that commercial testing had been generally disfavored in the past, and as a matter of fact, he himself had turned down several requests during the past year for commercial testing.

Dr. Hill agreed with Mr. Mensing that brains were preferred to resolutions, but reiterated his opinion that he did not believe commercial testing by our laboratory was advisable, and thought that our rules and regulations should not allow it. E. A. Jones drew attention to the possibility of a very extensive demand for commercial testing being created, should it be permitted, and cited as an example the experience of the *American Gas Association*. He also pointed out that some manufacturers would view with apprehension the possibility of their equipment being tested outside of the laboratory at Pittsburgh.

President Lewis read the wording of the regulations in order to clarify any misunderstanding which may have existed and Mr. Boyden emphasized the fact that the SOCIETY would be permitted to do commercial testing under the proposed regulations *only* upon application by engineering, scientific, or technical organizations, and associations of manufacturers. President Lewis said that the proposed regulation would restrict the authority of the Committee on Research with respect to commercial testing, while the previous regulation allowed the committee complete latitude in this respect. Dr. Hill then asked if his impression was correct that the proposed restriction would in a measure safeguard the laboratory with respect to commercial testing, but that the wording of the measure is such that commercial testing will be anticipated.

President Lewis then cited an example whereby a trade association had requested that a certain piece of apparatus be tested, the question arising as to whether or not this would be termed as commercial testing. Mr. Harding then told of the extensive discussions of this subject by the Committee on Research, and explained that in his opinion commercial testing would result, if the proposed resolution were adopted, but he called attention to the attitude of many members of the SOCIETY, namely that at present there is no place where a manufacturer can have his apparatus tested, other than commercial testing laboratories, but in most cases such laboratories do not have the required standing. Mr. Harding expressed the opinion that commercial testing would not destroy the function of our research laboratory, as a scientific institution, but would merely widen the scope of activities. He brought up the question of whether or not the individual who is not a member of some trade association was being safeguarded. He emphatically stated that much thought had been given by him to the subject of commercial testing and that he had only recently approved of the idea. W. A. Swain brought up the question of whether or not apparatus tested by the laboratory should be so indicated by a seal of approval, and C. G. Segeler of the *American Gas Association* told of the experiences of that organization in this regard. He stated that while at first the seal of approval of the *American Gas Association* meant three things, safety, quality and efficiency, the seal now means only one thing, namely, compliance with basic national standards for safety.

Perry West stated that although he had been opposed to commercial testing in the past, he was now thoroughly convinced that it was within the province of the SOCIETY to undertake this work. He felt that some of the reasons which existed in the past for avoiding commercial testing do not now hold true, because the SOCIETY has developed beyond the stage in which these factors apply. He felt that if the *American Gas Association*, the *National Board of Fire Underwriters* and other organizations successfully do commercial testing, there is no reason why we should not.

Prof. L. S. O'Bannon stated that he was not in favor of the laboratory, as it is at present organized, engaging in commercial testing. He favored creating a separate bureau with a separate head. E. A. Jones agreed with this suggestion and felt that a separate laboratory should be built for the sole purpose of conducting commercial tests. He suggested that the attention of the committee

be directed to the preparation of standards under which the commercial laboratory should operate. President Lewis stated that the viewpoint might be expressed that the SOCIETY could not develop to the point where there would be sufficient commercial testing to warrant the establishment of a separate bureau unless regulations were initiated under which such work can be received and started. According to his point of view, the Committee on Research is merely endeavoring to bring together all the regulations the SOCIETY has passed, and to correlate them so that they will not conflict.

Professor Rowley, the newly appointed Chairman of the Committee on Research, was next introduced by L. A. Harding, who expressed the view that the resolution contemplated would not necessarily open up the way for commercial testing, but that these regulations merely stipulate in a more definite form the conditions under which commercial testing might be done. He stated that he would dislike to have the SOCIETY get into routine commercial testing, such as is used by manufacturers for advertising purposes. Professor Rowley further stated that he would take the advice of those who have preceded him as Chairmen of the Research Committee. He expressed appreciation for the honor conferred on him, and hoped that the co-operation necessary to maintain the Research Department on a level above reproach, would be forthcoming from everybody concerned.

When the motion was voted upon the rules and regulations governing the Committee on Research as presented by the committee were unanimously adopted.

President Lewis then introduced D. M. Quay, a Past-President of the SOCIETY, who was instrumental in the establishment of the organization. He told briefly of how the SOCIETY was formed and expressed delight at being present at this meeting. The pioneers in the formation of the SOCIETY had no idea that the organization would develop to the present size, he said.

The first paper on the program of the morning session was entitled Effects of Air Velocity on Surface Coefficients by Rowley, Algren and Blackshaw. (Complete paper published in the December 1929, A. S. H. V. E. JOURNAL.) In the presentation of this paper, Professor Rowley reviewed some of the fundamentals relating to heat transmission and stated the reasons governing the desirability of the investigation covered by the paper. There are three resistances to an ordinary wall, namely, the air space resistances, the solid material resistances, and the surface resistances. The paper under consideration dealt with the surface resistances or coefficients.

Albert Buenger asked if he was correct in his understanding that the purpose of the tests was to substantiate data given in THE GUIDE to the effect that the coefficient for a 15 mile wind velocity is about three times that for still air. Professor Rowley replied that the results obtained indicated that this value is substantially correct, perhaps, being a trifle higher, but that the data in THE GUIDE are sufficiently safe.

In a written discussion by Perry West, he stated that this paper has opened up many points of interest on this subject, and suggested that it be followed to a conclusion. He especially emphasized the importance of accurate surface coefficient data in connection with glass and thin walls having high heat transmission. Joseph Porzel wanted to know if the experiments were intended to check the surface coefficients used in THE GUIDE. He also questioned whether or not tests conducted with small equipment approached with sufficient accuracy conditions existing in practice. Mr. Harding replied to this question by relating his experiences in connection with experimental work conducted at the University of Illinois with Prof. A. C. Willard. A point raised by Mr. Harding was the question of where the velocity should be measured with respect to the surface. Some investigators measure the velocity half an inch from the surface, whereas others measure it a foot away and entirely different results are obtained. He expressed the opinion that a problem closely associated with that under investigation by Professor Rowley and his colleagues, was that in connection with the correlation of the Weather Bureau data for the purpose of correctly measuring wind velocities in connection with building surfaces. This problem, as stated in a previous discussion, is under investigation at the present time at the laboratory, and it is the hope that a paper will be forthcoming on the subject in the near future. O. W. Walter pointed out that the coefficients used in THE GUIDE are based on so-called still air, but in reality the air is not actually still because of convection currents. Professor A. P. Kratz replied that there is a misunderstanding concerning the use of the term "still air." He stated that by this was meant the flow of air due to convection, which in reality was not still air. Mr. Pulvern told of an interesting article by William Nusselt which appeared in a German publication in December, 1922. In this article certain transmission tests were made, and the results checked almost exactly with those reported in the paper under discussion.

Professor Kratz stated that some formulae were presented in a paper submitted before the *A. S. M. E.* by R. H. Heilman for separating the effect of radiation and convection. He stated that he had applied these equations for the still air coefficient, and a very close check was obtained with the value obtained by Professor Rowley.

In concluding the discussion, Professor Rowley stated emphatically that it was not the intention of these tests to check the figures used in THE GUIDE which were thought to be in error. He added that the tests are proving that THE GUIDE figures are substantially correct. He further pointed out that an apparatus was being designed by means of which it will be possible to separate the heat given off by convection and that given off by radiation.

President Lewis called attention to the fact that the paper presented by Professor Rowley is a part of the co-operative work between the Research Laboratory and the University of Minnesota.

The next paper was that entitled The Absorption of Solar Radiation in its Relation to the Temperature, Color, Angle and Other Characteristics of the Absorbing Surface, by F. C. Houghten and Carl Gutberlet, which was presented by Director Houghten. (Complete paper published in the December 1929, JOURNAL.) He emphasized the importance of an accurate knowledge of the amount of heat absorbed by building surfaces from the sun.

In a written discussion by H. H. Kimball, it was stated that it is unfortunate that the authors had accepted the work of F. H. Bigelow as authoritative on solar radia-

tion. Mr. Kimball stated that it appears that attention to the orientation of buildings, to the materials of which they are constructed, and to the character of paint or other surface covering, will assist materially in the conserving or excluding of solar heat, as circumstances may make desirable.

E. R. Queer stated that some similar experimental work was conducted at the Pennsylvania State College, and that the results obtained agreed very closely with those reported in the paper under discussion.

In concluding the discussion of this paper, Mr. Houghten stated that exception had been taken to values given in the paper relative to the total heat coming from the sun, but that as far as this paper was concerned, this value was of no consequence.

Preventing Condensation on Interior Surfaces by Paul D. Close, was then presented by the author. (Complete paper published in the September 1929, A. S. H. V. E. JOURNAL.) He stated that when the temperature of a surface is below the dew-point temperature, condensation takes place, which is often a serious problem and one at times difficult to solve. It can be prevented in either of two ways, by increasing the surface temperature or by lowering the humidity. In most cases the only alternative is to increase the surface temperature, which can be most readily accomplished by adding a sufficient thickness of insulation.

In a written discussion R. C. Parlett stated that too much emphasis cannot be given to the fact that where high humidities exist, insulation cannot always be used to prevent condensation. He also concurred in the statement made in the paper that it is advisable in most cases to apply the insulation over the roof deck after installing a suitable vaporproofing membrane.

L. A. Harding expressed the belief that the average engineer who is not familiar with the causes of condensation is under the impression that insulation is a cureall for this evil. As the relative humidity approaches 100 per cent, the thickness of insulation approaches infinity, and as stated in the paper, the point is reached where the thickness of insulation is beyond practical limits.

Before closing the morning session, President Lewis expressed appreciation to the publishers of *Heating and Ventilating* for the excellent exposition supplement they had issued and he also expressed appreciation for a special issue prepared by *Oil Heat*.

# Fourth Session—Wednesday, January 29—2:30 P. M.

The first item was the report of the Committee on the Code for Testing and Rating Unit Heaters by D. E. French, Chairman, who said that his Committee has been co-operating with the *Industrial Unit Heater Manufacturers Association*, and the joint Code Committee undertook the drafting of the code two years ago, the preliminary draft having been presented to the *Industrial Unit Heater Association* a year ago. The assistance of the Research Laboratory of this Association and the University of Kentucky were enlisted to obtain further refinements, and with the benefit of these opinions a preliminary draft was submitted to the *Industrial Unit Heater Association* at the Summer Meeting of the SOCIETY at Bigwin Inn. It was decided to try the code in practice for a period of time, the result being that the code reflects the experiences obtained in these practical trials.

The committee endeavored to strike a compromise between the high degree of scientific accuracy expected of the SOCIETY and the commercial standards tolerable by the manufacturers association. The code as presented was primarily one for laboratory tests, its use in the field being thereby restricted, and had been adopted the previous day by the *Industrial Unit Heater Manufacturers Association* with the exception of an amendment to paragraph O on page 13. (Advance copies of the Code were sent to all SOCIETY members and the full text will appear in a future issue.)

The code was presented for adoption by Mr. French with the understanding that certain minor changes were to be made, which he outlined. These changes were accepted by the *Industrial Unit Heater Manufacturers Association* in advance. It was moved and seconded that the report of this committee be adopted as a code of the SOCIETY, and the matter opened for discussion.

L. W. Child stated that the code agrees very closely with the data and procedure his organization has been using. However, they have added a condensation cooler to the condensate line, to prevent the water from bursting into steam. This organization also uses a check on the amount of air delivered by the fan, the check test being taken with a Pitot tube or by means of a calorimetric method. Another point brought up by Mr. Child was the matter of obtaining final temperatures with accuracy.

Mr. Wendell then recommended changes in the code, revisions of testing equipment, and revisions of test computations. He stated that he believed the code should start with a statement to the effect that the unit heater tested should be a stock unit containing a steam-tight heating element, and that the fan and motor should be run for approximately a day before testing to break in the bearings.

Mr. Wendell further stated that it was his opinion that the standard air reference should be limited to one and not two states of air. He referred to Article 15, on page 5 and suggested that the number of tests be reduced to two. As to Article 45, page 7, he suggested that the test pressure control be accomplished by an automatic pressure-reducing valve. The value of 55.2 in formula (2) of Article 56, would be 55.3 for the weight and specific heat of air suggested by Mr. Wendell. The assumption in Article 59, page 8, relative to a constant volume of air, is not followed out under Computations of Results, according to this speaker, and consequently in the sample computations on page 12, and it was therefore contended that the code is inconsistent. He stated that the sample data on page 12 are not correct if computed according to the prescribed formula, as the values are about two per cent too high. He believed that reference should be made to results obtainable with a proper thermocouple installation, the use of which is prohibited for air measurements in the code.

In the revision of testing equipment recommended by Mr. Wendell the opinion was expressed that the number of tests should be reduced from four to two tests per

set of output data by the introduction of the zero static chamber at the inlet side of the heater. It was further suggested that the unit heater be placed in an airtight zero static chamber, that the air supplied through the zero static chamber be measured in a round duct with air flowing at 2,000 to 3,000 feet per minute, that the air outlet temperature be computed from condensation and air volume, and that a second test be run without the zero static chamber or with one or more walls of the zero static chamber removed so as to obtain the condition of free air delivery to and discharge from the unit heater. As to the recommended revision of test computations, Mr. Wendell entered into a mathematical analysis of the problem, giving a method for the determination of output data for steam pressures and inlet air temperatures other than that required for standard two-pound steam and 60 deg. inlet air.

Professor O'Bannon stated that in some of the computations constant weight is assumed, although later on in the procedure, corrections are made in a logical way for this original assumption of constant weight to correct for constant volume. Mr. Child stated that although there is a definite mathematical relation between the $K$ value and the net velocity for floor type draw-through unit heaters, with the suspended type no such relationship seems to exist. He stated that on one type of unit on which he has made tests, he has found that the $K$ value will vary as a function of the mass velocity, but if the same unit has a propeller type fan in front of it, the $K$ value will vary from 20 to 40 per cent higher. It is therefore impossible to plot points on logarithmic paper and get a straight line.

In a written discussion by E. J. Vermere, he stated that according to his analysis of all the percentages of error possible under the methods proposed by the code, the error is approximately 2.6 per cent. He stated that the code in the proposed form entirely ignores heat diffusion, and that when both the velocity and the temperature of the air leaving the unit are ignored, the rating is based solely on condensation. Mr. Vermere expressed the opinion that the greatest service the SOCIETY can render in this connection is to obtain data regarding heat diffusion in relation to temperature differentials and outlet velocities.

W. A. Rowe, a member of the Committee, stated that the committee was composed partially of fan men and partially of men who have not been active in fan work. He related some of the experiences in connection with the development of the code, particularly with respect to the measurement of the air volume. After encountering many obstacles in determining a correct method of ascertaining the air volume, the committee called on the SOCIETY, and the assistance of the University of Kentucky was solicited. Professor O'Bannon undertook an investigation, the results of which were reported at the Summer Meeting at Bigwin Inn, Canada. He explained that the easier way was to measure the temperature rise, if sufficient precautions are taken to mix the air and measure it at a reasonably high velocity. He said that it was a simple matter to measure the temperature at a high velocity by means of a calibrated nozzle and taking one reading on the manometer, which he thought was much more accurate than a Pitot-tube traverse.

Mr. Rowe stated that they had the benefit of able engineering advice on the code from Mr. Harding, Professor O'Bannon and others. The code, he stated, is easy to use, and is sufficiently accurate for commercial purposes. Whatever corrections or minor changes are required will, of course, be given attention.

O. K. Dyer said that the committee realized that the temperature at which the air is discharged has an important bearing on the amount of heat given off by the unit. He felt that all realized the need of a code, and felt that the one presented was workable and would serve the purpose.

In closing the discussion, Mr. French mentioned that the addenda recommend the use of a condensate cooler for greater accuracy. He agreed with Mr. Child that an air check is desirable. He stated that the matter of running the heater a day in order to loosen the bearings was discussed, but that this was not regarded necessary in view of the fact that a calibrated motor is called for, which would automatically provide for the loosening of the bearings. As to the definition of standard air, Mr. French stated that the definition adopted was that already in use in the fan test code of the SOCIETY. The matter of thermocouples had been discussed to a great extent and it was after the instrument manufacturers themselves had recommended that they be not used on the entering air side, that this revision was made. Mr. French discussed the question of excess resistance of the heater, and also the alternate method proposed for the computation of results and the computation of the rating on the basis of alternate conditions. Many different methods of computation were considered, and the committee decided on the method that was generally preferred and best adapted in the hands of the majority.

Professor O'Bannon said that he had read the code through, and thought that there were a number of minor changes he would like to make, which were more of an academic nature than fundamental. Mr. Flink suggested that the code be referred back to the committee for consideration of the various suggestions that had been made, to which President Lewis replied that the incoming President, Mr. Harding, had assured him that he intends to appoint a Continuing Committee which would serve this purpose, the main object being to get it into use as soon as possible. Mr. Nobis called attention to the possibility of dust and dirt collecting on the horizontal areas decreasing the capacity of the heater, and while President Lewis agreed that this was a good point, he also stated that this is more or less true of all kinds of heating surface, and he did not see how this could be covered in a rating or testing code.

There being no further discussion, the motion was voted upon and carried that the report thus be adopted as a code of the SOCIETY.

A Method of Testing Unit Heaters Suitable for Field Use by Prof. L. S. O'Bannon, was presented by the author. (Complete paper published in February 1930, A. S. H. V. E. JOURNAL.) After the presentation, President Lewis pointed out that the SOCIETY now has a code suitable for laboratory tests and also that Professor O'Bannon has suggested a simple method by which tests can be made in the field. Mr. French expressed his appreciation of Professor O'Bannon's paper. He emphasized the desirability of a method by which the engineer can take the manufacturer's catalog rating for a

given set of conditions and determine an accurate rating at any other set of conditions. Mr. Child stated that he had used a method of computation similar to that suggested by Professor O'Bannon for about two years, and discussed some of the results he had obtained, making certain suggestions regarding the formulae involved. In closing the discussion, Professor O'Bannon called attention to the importance of the proper design of the nozzles. The resistance should be neither too great nor too little, he stated, so that it is necessary in the design of the nozzles to strike a happy medium that is correct for the fan characteristics.

Before proceeding with the next paper, President Lewis called on W. H. Driscoll, a Past-President of the SOCIETY, who expressed great satisfaction at the progress the organization is making, and related some of the experiences of the organization of 25 years ago.

The paper entitled Measurement of the Flow of Air through Registers and Grilles was presented by the author, Prof. L. E. Davies of Armour Institute. (Complete paper published in January 1930, A. S. H. V. E. JOURNAL.) In introducing Professor Davies, President Lewis congratulated the author on the excellent work done in connection with the experiments involved, and hoped that subsequent papers would be forthcoming on this subject, as additional information is gleaned. The investigation undertaken by Professor Davies had its inception as the result of an ordinance of the City of Chicago requiring certain tests to be conducted after ventilating equipment had been installed. The problem involved was the accurate determination of the volume of air flowing from registers or grilles. This particular investigation was the result of co-operative work between the Laboratory of the SOCIETY, Armour Institute of Technology of Chicago, and the *Ventilating Contractors Employers Association of Chicago.*

S. H. Givelber asked what practical method Professor Davies would recommend for determining the free area of an ornamental iron grille. Mr. West inquired about the method Professor Davies used to adjust the thermometer to a distance of 3 in. from the grille, and to maintain that adjustment. Mr. Howatt explained some of the details in connection with the instigation of this study. Miss Ingels wanted to know if, when the dial of the anemometer was turned toward the exhaust to take care of the backward flow of the air, necessitating that the blade be kept ¼ in. from the face of the register, whether that difference would be an appreciable amount, as compared with the anemometer being flush with the surface. Prof. J. R. McColl asked how much time was given to the position of the anemometer in one part of the grille. L. A. Harding suggested that the time is ripe for the development of a code covering the measurement of air through registers, grilles, etc.

In reply to the various questions, Professor Davies admitted that it was a somewhat difficult matter to determine accurately the net free area of the cast-iron grille. As to the method of maintaining the proper distance from the grille, Professor Davies stated he used a small strip of brass, small enough that it would not interfere, but large enough to provide a rest for the anemometer.

As to the possible error resulting from the anemometer being away from the face of the grille, Professor Davies stated that this was one of the first factors that occurred to him at the beginning of this investigation, but he found upon experiment that the readings taken on the supply side 1 in. or so away, differed very little from the readings taken in contact with the grille, but he believed that it would not be the same on the exhaust side. So, the glass was removed for a few runs to place the instrument as near to the face of the grille as was possible, and although some difference was indicated, it apparently was not of any great importance.

Professor Davies said that he used the flying start method of taking the readings which covered about half-minute each. He pointed out that the greatest error in taking a moving traverse is likely to occur where there is a wide variation in the velocity, and he declared that there is a tendency to hurry past the point of low velocity. He also emphasized the fact that more time should be given for large surfaces, using not less than two minutes on a grille of the size of the one he used (2 ft. sq.).

P. J. Marschall emphasized the importance of calibrating an anemometer before a test is made. President Lewis concurred in this suggestion, especially with such a delicate instrument.

President Lewis then entertained a motion to the effect that the incoming President appoint a committee for drawing up a code for the measurement of air through grilles, which motion was made, seconded and carried.

Thomas Dugan of Pittsburgh next gave a report of the Sub-Committee on Pipe Fittings and Flanges, which Sub-Committee is a part of the *American Standards Association,* and requested that any suggestions concerning this matter be forwarded to him immediately in order that they could be given due consideration.

# Fifth Session—Thursday, January 30—9:30 A. M.

President Lewis read a letter from G. N. Haden, one of our members in England, who extended his wishes for a successful meeting, and recalled the pleasant visits he had had with various members of the SOCIETY who had visited England.

C. W. Obert, former Secretary of the SOCIETY, was introduced and expressed great pleasure at being able to attend the meeting, and also expressed great enthusiasm at the tremendous registration.

The first item scheduled for this session was the report of the Continuing Committee on Codes for Testing and Rating Steam Heating Solid Fuel Boilers, which was submitted by L. A. Harding, *Chairman.*

## Report of Continuing Committee on Codes for Testing and Rating Steam Heating Solid Fuel Boilers

This committee was charged by the Society to review and report on:

1. A.S.H.V.E. Code for Testing Steam Heating Boilers (adopted January, 1929).

2. A.S.H.V.E. Code for the Rating of Heating Boilers Burning Solid Fuel (adopted January, 1929).

The committee suggested several minor changes in the test code at the 1929 summer meeting, which were adopted by the Society and designated A.S.H.V.E. Codes 1 and 2.

Standard and Short Form Heat Balance Codes for Testing Low Pressure Steam Heating Solid Fuel Boilers. It also presented an additional test code known as the A.S.H.V.E. Performance Test Code of Steam Heating Solid Fuel Boilers, which was likewise adopted by the Society. The committee presented a suggested revision in the rating code at the summer meeting with the further suggestion that no action be taken at that time.

In the following report the committee has endeavored to review briefly and discuss several suggested methods of rating boilers, also the warm air furnace rating code in the following order:

1. A.S.H.V.E. Code for Rating Heating Boilers Burning Solid Fuel.
2. Recommended revision of the A.S.H.V.E. Rating Code.
3. A Rating Code as adopted by the Steel Heating Boiler Institute, Dec. 10, 1929.
4. A rating code for warm air furnaces for gravity circulation, the first edition of which was approved by the Society in 1923.

### Comments on the Committee Concerning the Subject of Boiler Rating

#### Object of Rating Codes

The committee believes that the principal objects of any rating code are:

(*a*) To furnish the purchaser with sufficient information in reference to the apparatus rated that he may make an intelligent selection to suit his particular needs and requirements.

(*b*) It is further apparent that the information conveyed by the rating should be given in some uniform manner in order that an intelligent price comparison may be made between similar apparatus as manufactured by different concerns.

Assuming that this general conception of a rating code is correct, it would appear that it is difficult, if not altogether impossible, to entirely divorce the subject of selection from rating. A dual responsibility exists between the purchaser and manufacturer if any installation is to be successful from the standpoint of operation. The manufacturer is responsible for furnishing correct, reliable and sufficient information regarding the apparatus and the purchaser is evidently responsible to the extent of utilizing the apparatus in a manner which is consistent with the information as furnished.

If the purchaser is provided with a uniform method for determining the loads under which the apparatus is to be employed, as for example the A.S.H.V.E. Code of Minimum Requirements for Heating and Ventilation of Buildings (Section V) which specifies the manner by which the design load and maximum load are to be determined, then it is apparent that it is incumbent upon the manufacturer to furnish at least this much guaranteed information regarding his apparatus, if the purchaser is to fulfill his part of the assumed obligation for a successful installation which it must be assumed is the object sought by all concerned in the matter.

It is apparent that the adoption of any rating code which does not permit the provisions of the A.S.H.V.E. Code of Minimum Requirements for the Heating and Ventilation of Buildings being carried out would require a revision of this code as now written.

The following extract from the A.S.H.V.E. Code of Minimum Requirements for the Heating and Ventilation of Buildings is frequently referred to in this report:

## SECTION V

## MINIMUM CAPACITY AND INSTALLATION REQUIREMENTS FOR LOW PRESSURE STEAM AND HOT WATER HEATING BOILERS

employing solid fuels stated in B.tu per hour shall be taken as the sum of the following items:

(*A*) The estimated heat emission in B.tu per hour of the connected radiation, direct, indirect or both, to be installed as determined by computation from data given in Sections II and III for normal operation.

(*B*) The estimated maximum heat in B.tu per hour required to supply water heaters or other apparatus to be connected to the boiler or boilers.

(*C*) The estimated heat loss in B.tu per hour of the piping connecting radiation and other apparatus with the boiler or boilers (see Table 1).

(*D*) The estimated increase in the normal load in B.tu per hour due to starting with cold piping and radiation. This increase is to be based on the sum of items (*A*), (*B*) and (*C*) and shall be assumed not less than the following:

TABLE 1—PERCENTAGE INCREASE TO BE ADDED TO NORMAL LOAD

| SUM OF ITEMS (*A*), (*B*) AND (*C*) IN B.TU PER HOUR | EQUIV. STEAM RADIATION SQ. FT. (240 B.TU PER SQ. FT.) | PERCENTAGE INCREASE TO BE ADDED |
|---|---|---|
| Up to 100,000 | Up to 417 | 65 |
| 100,000 to 200,000 | 417 to 834 | 60 |
| 200,000 to 600,000 | 834 to 2502 | 55 |
| 600,000 to 1,200,000 | 2502 to 5004 | 50 |
| 1,200,000 to 1,800,000 | 5004 to 7506 | 45 |
| Above 1,800,000 | Above 7506 | 40 |

(1) Estimated Boiler Load: For the purpose of this Code the estimated connected load to the boiler or boilers.

(2) Boiler Capacity to Be Installed: The boiler or boilers to be installed shall be guaranteed by the manufacturer of the boiler to be capable of supplying, at the boiler outlets, the total B.tu per hour as computed by the method outlined in the preceding paragraph and under the following conditions of operation each of which is to be stated in the specifications covering the installation for which the boiler or boilers are intended.

$$\text{The Heating-Up Factor} = 1 + \frac{\text{Table Percentage}}{100}$$

It appears to this committee that a rating code for any type of apparatus must of necessity include the following items:

1. The output.
2. Specified conditions of operation for the output stated.
3. The limits placed on certain specified conditions.

It is also obvious that one must reproduce the conditions in practice under which the apparatus was originally rated if comparative results are to be realized or attained. It is necessary to standardize limits for some of the specified conditions, otherwise a rating code could not fulfill its function. Some of the limits to conditions are naturally now set by custom and usage or by ordinances or laws, designed to protect the health and safety of the community. For example, custom and usage have decreed that the conditions relative to steam pressure for rating purposes, shall be 2-lb. gauge at the boiler for heating boilers, and 2 per cent priming, whereas, overall efficiency, draft tension, temperature of flue gas and rate of combustion are conditions over which it is difficult at least to assign exact or definite limits in the present state of this art.

Placing a minimum value limit on boiler efficiency covering the average load period of the heating season, would appear to be in line with a program of fuel conservation and would probably receive a welcome by prospective owners of heating boilers. Not the least item, however, in boiler economy is the manner in which the boiler is actually operated by the owner and over which the manufacturer has no actual control. The manufacturer can and does produce boilers which give relatively high efficiencies when properly operated but it is difficult to set a minimum efficiency limit that would produce the actual results apparently desirable.

This Committee is fully cognizant of the fact that no rating code can be devised that will make proper boiler selection for estimated loads automatic or will entirely remove the possibility of making errors in selection. The same degree of intelligence must apparently be employed in selecting a boiler from manufacturers' data that the purchaser displayed in the more intricate calculation of the heat losses for the correct selection of the amount of radiation to be installed.

## DEFINITIONS

There are a number of terms employed in this art, the meaning of which is either vague, not clear or by no means standardized. In order to avoid any misunderstanding of the interpretation of the various terms employed in this discussion, the following definitions have been included:

**Purchaser:** Construed to mean the person responsible for the selection of the boiler.

**Equivalent Direct Radiation:** The heat emission of 240 B.tu per hour per square foot of manufacturers' rated surface of direct steam radiation and 150 B.tu per hour per square foot of manufacturers' rated surface of direct hot water radiation.

**One-Number Boiler Rating:** A single rating stated for each boiler listed in a manufacturer's catalog.

**Multi-Number Boiler Rating:** Two or more ratings stated for each boiler listed in a manufacturer's catalog.

**Dimensional Boiler Rating:** A one-number rating based on some physical dimension of the boiler, as for example the grate surface, boiler heating surface, or both.

**Heating Boiler Output:** As defined by the A. S. H. V. E. Performance Test Code for Steam Heating Solid Fuel Boilers (adopted June, 1929).

**Grate Area:** As defined by the A. S. H. V. E. Code for Testing Low Pressure Boilers Burning Solid Fuel. (1929 edition.)

**Boiler Heating Surfaces:** The sum of the areas of all surfaces in the boiler which are exposed to the products of combustion on one side and water on the other side measured in square feet.

**Boiler Efficiency:** The over-all efficiency of grate and boiler as defined by the A. S. H. V. E. Performance Test Code for Steam Heating Solid Fuel Boilers (June, 1929 edition).

**Priming:** The amount of free moisture carried by the dry saturated vapor delivered by the boiler outlets stated as a percentage of the sum of the weights of dry saturated steam plus the free moisture delivered at boiler outlets.

**Estimated Design Load:** The load, stated in B.tu per hour or equivalent direct radiation, as estimated by the purchaser for the conditions of inside and outside temperature for which the amount of installed radiation was determined and is the sum of the heat emission of the radiation to be actually installed plus the allowance for the heat loss of the connecting piping plus the heat requirement for any apparatus requiring heat connected with the system. (A. S. H. V. E. Code of Minimum Requirements for the Heating and Ventilation of Buildings).

**Estimated Maximum Load, Peak Load, Starting-Up Load:** These terms are considered synonymous and are construed to mean the load, stated either in B.tu per hour or equivalent direct radiation determined by the purchaser to be the greatest estimated output that the boiler will be called upon to carry in operation. The maximum load is a function of the time assumed to raise the temperature of cold piping and radiation to normal operating temperature. The committee recommends the use of the term *estimated maximum load* in this connection. (See Section V, A. S. H. V. E. Code of Minimum Requirements for the Heating and Ventilation of Buildings.)

**Net Load:** This term as now employed in heating literature has various meanings, *viz.*, installed direct radiation, design load and maximum load. The committee recommends that this term be dropped from heating literature as serving no especially useful purpose.

**Estimated Average Load:** The estimated average load stated in B.tu, per hour of equivalent direct radiation for the heating season and based on the average outside temperature during the heating season for the locality in question.

**Heating-Up Factor:** The factor by which the estimated design load is multiplied in determining the estimated maximum load. This is equal to $1 + \frac{\text{Percentage added}}{100}$. (See Section V, A. S. H. V. E. Code of Minimum Requirements for Heating and Ventilation of Buildings.)

Also see *Time Analysis in Starting Heat Apparatus,* by Ralph C. Taggart, A. S. H. V. E. Transactions, Vol. 19, 1913, for a complete mathematical treatment of this subject. This paper gives heating-up factors or per cent overload based on the design load for various lengths of time required to warm up or start the heating apparatus. The author calls attention in this paper to the fact *that Boiler Performance Curves are desirable.*

The heating-up factor is dependent upon the time permitted or assumed for completely heating all the piping and radiation to operating temperature. The shorter the time the greater the boiler output required. If approximately two hours are allowed for this operation with cast iron radiation, the heating-up factor approaches a value of 1 and the boiler is therefore subject to no overload from this cause.

Heating-up factors as determined by Section V of the Code of Minimum Requirements for the Heating and Ventilation of Buildings are, it is believed, considered reasonably satisfactory by heating engineers.

The following approximate analysis of the heating-up load for a steam system although not strictly accurate, will serve to illustrate the fact that normally the maximum load on any heating boiler is determined by the time that is allowed or assumed to raise the temperature of cold radiation to normal operating temperature.

The following assumptions are made:

Weight of radiation and piping: 8 lb. per square foot of installed equivalent steam radiation. Specific heat of iron: 0.12. Initial temperature of iron: 40 F. Final temperature of iron: 215 F. Temperature of air surrounding radiation: 40 F and assumed constant during the heating-up period. Unit heat emission for radiating surface: 1.7 B.tu per hour per square foot per degree difference in temperature between radiating surface and the air. Heat emission of radiation: 240 B.tu per hour per square foot in normal operation. Time allowed for the heating-up period: 45 minutes or ¾ hour.

To heat the iron requires: $8 \times 0.12 \quad (215—40) = 168$

B.tu per square foot of radiation. The heat emission of the radiation during the heating-up period is approximately:

$$\frac{3}{4} \times 1.7 \left( \frac{215 + 40}{2} - 40 \right) = 111.6 \text{ B.tu per square foot}$$

The total heat to be supplied by the boiler in ¾ hour is therefore:

$168 + 111.6 = 280$ B.tu, or at the rate of

$280 \times 4/3 = 373$ B.tu per hour.

The boiler for the assumed conditions evidently must be capable of delivering $\frac{373}{240}$ or 1.55 (heating-up factor) times as much heat as is required for normal operation.

**Attention, Firing Period, Fuel Available in Hours:** The hours required to burn one available fuel charge. Fuel available is defined in the A. S. H. V. E. Performance Boiler Test Code for Steam Heating Solid Fuel Boilers. The committee recommends the discontinuance of the use of the terms *attention* and *firing period.*

## (1) A.S.H.V.E. CODE FOR RATING HEATING BOILERS BURNING SOLID FUEL (ADOPTED JAN., 1929)

The rating of a boiler under this code requires that a series of tests be conducted under the rules of the A. S. H. V. E. Code for Testing Steam Heating Boilers to determine the actual output of the boiler covering a number of rates of combustion with a fuel having a calorific value of 12,500 B.tu per pound and corresponding recorded flue gas temperatures. These two items are plotted against output on a chart which is part of the Code.

The intersection of the combustion rate curve and flue gas temperature curve with corresponding lines printed on the chart each correspond to some output. The A. S. H. V. E. Rating output is the lower of the two outputs determined in this manner, plus 30 per cent of their difference providing the priming does not exceed two per cent moisture and that the $CO_2$ in the flue gases is not less than 12 per cent by volume.

The Code states: Rating outputs conforming to this Code shall be known as A. S. H. V. E. Rating.

This Code fixes the *maximum output* that may be designated as the A. S. H. V. E. Rating. The output allowed by this Code may require a higher draft or other operating characteristic than the manufacturer would desire when listing the boiler for average use; this Code allows that a lower rating output (assumed maximum) may be chosen and listed as the A. S. H. V. E. Rating.

This scheme evidently provides a *one number maximum output rating* as determined by providing certain limits on the operating conditions. The following paragraph appears under the heading *Purpose:*

This Code is not intended to supplant the more correct engineering practice of determining the available output of boilers for specified operating conditions by a study of analysis of the complete data given by *performance charts* nor does it preclude the assigning of other rating output values to meet purchasing specifications or a specified set of operating conditions. The rating outputs as determined by this Code are intended for average conditions and for the use of purchasers not competent or desirous of making comparisons and selections from performance charts.

The intent of the last sentence in the preceding paragraph is not entirely clear. The purchaser provided with *only* the maximum output of the boiler would necessarily have to be sufficiently competent to select and apply a safe heating-up factor to his estimated design load to arrive at the maximum load in order to select the correct boiler rated in this manner, or the maximum output rating as given by the manufacturer would have to be divided by the purchaser's assumed heating-up factor to arrive at the output rating corresponding to the estimated design load. In either case it must be assumed that the purchaser is sufficiently competent to apply the provisions of Section V of the A. S. H. V. E. Code of Minimum Requirements for the Heating and Ventilation of Buildings.

The committee interprets the term *performance charts* to include performance tabular data from which charts may be constructed. The committee infers that a boiler rated in this manner is not to be connected with a greater maximum load than is determined by the provisions of Section V, A. S. H. V. E. Code of Minimum Requirements for the Heating and Ventilation of Buildings. A more detailed discussion of this Code appears later in this report.

## (2) SUGGESTED REVISION OF A.S.H.V.E. RATING CODE

This revision is intended to provide a Code which requires the manufacturer, if he employs the A. S. H. V. E. Rating, to supply sufficient tabular output data for the construction of performance charts, which it is believed is in accord with the trend of modern engineering practice. The suggested revision requires a minimum of five outputs having a range from maximum output listed to at least 35 per cent of maximum output for the minimum output listed.

The only limit placed on the operating conditions for the outputs listed is that priming shall not exceed 2 per cent. Under each output listed the proposed revision requires numerical values for each of the following items:

1. Fuel available.
2. Combustion rate.
3. Efficiency.
4. Draft tension.
5. Chimney dimensions.
6. Flue gas temperature.

This scheme provides the purchaser with complete information as to the performance of the boiler under conditions as specified. It is recommended that the manufacturer print in bold face type or otherwise designate one of the output ratings listed for each boiler which will correspond with the provisions of Section V of the A. S. H. V. E. Code of Minimum Requirements for the Heating and Ventilation of Buildings. This feature also automatically provides a one-number design-load output rating.

Furthermore, the purchaser with a multi-rating system is afforded the opportunity not provided by a single number rating, of selecting or comparing boilers to suit his individual idea and requirements as to economy, firing period, draft, or height of chimney available, etc. The committee believes that the purchaser of any apparatus is entitled to full information in regard to its operating characteristics. A more detailed discussion of the proposed code appears later in this report.

### Discussion of A.S.H.V.E. Code for Rating Heating Boilers Burning Solid Fuel (Adopted January, 1929)

The committee in applying this code to the rating of those boilers for which performance data were made available by boiler manufacturers found in many cases that either the combustion rate performance curve from the test data, or the flue gas temperature performance curve, or both, did not intersect the corresponding combustion and flue gas temperature limitation lines as contained in the Code.

Extrapolation of the performance curves beyond the test data in practically all cases examined gave a rating larger than the manufacturer's catalog rating. This condition is natural as the manufacturer's rating is perhaps more often intended to correspond to the design load to which the boiler is to be connected and *not* the maximum load to be carried during the heating-up period.

Figures* 1, 2, 3 and 4 show the application of the A. S. H. V. E.

* Figs. 1 to 7a, inclusive, and Table 2 appear in Continuing Committee Report mailed to members before the meeting.

Code for Rating Heating Boilers Burning Solid Fuel to several boiler performance charts. Figs. 6 and 6*a* show the application of the A. S. H. V. E. Code for Rating Heating Boilers Burning Solid Fuel to four cast-iron sectional type boilers of the same make. It will be observed that the maximum output as determined by this Code parallels with and is fairly close to that as reported by the manufacturers for maximum output. In both cases the rate of combustion *decreases* as the grate area and output *increases.*

The application of the A. S. H. V. E. Rating Code to six cast-iron magazine type boilers of the same make is shown by Figs. 7 and 7*a*. It will be observed that the maximum output rating as determined by the Code requires a *decreasing* rate of combustion as the grate area and output increases. The rate of combustion for the manufacturer's design output rating and maximum output rating however, increases with the increase in output and grate area.

Referring to Table 2 and Fig. 5, it will be observed that when the present rating Code is applied to determine the *maximum output,* and the Code of Minimum Requirements for the Heating and Ventilating of Buildings is employed to determine the output corresponding to the design load, in many cases this latter output compares favorably with the manufacturers' catalog rating for boilers below 3,000 sq. ft. rating. Above this rating, however, the comparison is not so obvious. The committee believes it is impractical at the present time at least, to assign limits to a combination of combustion rate and flue gas temperature, without considering the $CO_2$ limit, which would be reasonably equitable to the many and varied designs of heating boilers now available or in contemplation. The committee can find no precedent in which a condition affecting the efficiency of the apparatus is limited. Limits placed on flue gas temperature and $CO_2$ would undoubtedly have an effect on efficiency. *It is believed by this Committee that it is the prerogative of the manufacturer to decide on the maximum output rating he desires to publish for any boiler he manufactures.*

The corresponding *design load* to which the boiler may be connected is determined by dividing the maximum output rating by the heating-up factors as given by the A. S. H. V. E. Code of Minimum Requirements for the Heating and Ventilation of Buildings employing the same chimney. It is not likely that a manufacturer would willfully specify or require the installation of a chimney height beyond customary practice for the sole purpose of obtaining a high rate of combustion and therefore increased maximum output rating. See Section VII, A. S. H. V. E. Code of Minimum Requirements for the Heating and Ventilation of Buildings for minimum height of chimneys.

## RECOMMENDED REVISION OF THE JANUARY, 1929, A.S.H.V.E. CODE FOR RATING STEAM HEATING SOLID FUEL HAND-FIRED BOILERS

### (1) PURPOSE

The purpose of this Code is to standardize the method to be employed and followed by any person, partnership, firm, corporation or association, who may desire to make use of or employ for any purpose whatsoever the statement: "The rating of the boilers herein listed are in accordance with the provisions of the A.S.H.V.E. Code (year) for Rating Steam Heating Boilers Burning Solid Fuel."

### (2) RATING DESIGNATION

It is understood that all ratings stated are guaranteed boiler outputs by the manufacturer for the corresponding boiler designation as were determined and defined by the provisions of the "A.S.H.V.E. Performance Test Code for Steam Heating Solid Fuel Hand-Fired Boilers (1929)" and as governed by the conditions as set forth under paragraph (4) and accompanying the ratings.

The output for each boiler shall be stated in thousands B.tu per hour and also in square feet of equivalent direct radiation. It shall be optional to state, in addition to the two methods indicated, the output in pounds of steam per hour.

### (3) RANGE OF OUTPUTS FOR EACH BOILER LISTED

There shall be stated a minimum number of five boiler outputs for each boiler listed. The outputs shall have a range from maximum output to approximately 30 per cent of the maximum output and the intermediate outputs given are to be approximately equally spaced between the minimum and maximum outputs.

The manufacturer shall print in bold face type or otherwise designate the output rating of each boiler corresponding to the design load to which the boiler is intended to be connected as determined by the provisions of Section V of the A.S.H.V.E. Code of Minimum Requirements for the Heating and eentilation of Buildings.

### (4) LIST OF CONDITIONS, STATEMENTS OF LIMITING CONDITIONS AND MANUFACTURERS' GUARANTEE

There shall be stated under each output listed the numerical values for each of the following five items:

1. Fuel available in hours.
2. Combustion rate, pound per hour per square foot of grate surface.
3. Over-all efficiency, per cent.
4. Average draft tension, inches of water.
5. Interior dimensions of chimney and height.
6. Average flue-gas temperature, degrees Fahrenheit.

The following statements shall be included with the rating tables: "The priming for any output listed does not exceed two (2) per cent."

For Anthracite Fuel

"The ratings are based on a steam pressure of 2-pound gauge at the boiler and anthracite coal stove size, having a calorific value of 12,500 B.tu per pound on a moisture-free basis."

For Bituminous Fuel

"The ratings listed are based on a steam pressure of 2-pound gage at the boiler and bituminous coal 3 in. by 2 in. size, having a calorific value of 13,000 B.tu per pound sulphur content not exceeding 2 per cent and volatile content of not less than 30 per cent on a moisture-free basis."

For Coke Fuel

"The ratings listed are based on a steam pressure of 2-lb. gage at the boiler and by-product or gas coke of commercial size best suited to the boiler."

"The inside dimensions and height of chimneys listed should be satisfactory when properly constructed and having no other opening except for the purpose of serving the boiler and when free from the effect of adverse air currents. Allowance should be made for any other chimney openings, elbows in the smoke flue or breeching and for extra long smoke flue or breeching."

### (5) TABLE OF DIMENSIONS

A comprehensive table of dimensions of the boilers listed shall be included in the same bulletin or catalogue with the ratings. This table shall include the number and pipe size of steam and return connections and location, smoke flue dimensions and height above floor line, grate area and height of boiler-water line and such other dimensions as may be required for properly indicating the boiler to scale on a set of complete heating installation plans.

### (6) DEFINITIONS

Purchaser:

Construed to mean the person responsible for the selection of the boiler.

Manufacturer:

The individual, firm or corporation who manufactures the boilers for which corresponding ratings are listed.

Boiler Output:

As defined by the proposed A.S.H.V.E. Performance Test Code for Steam Heating Solid Fuel Boilers.

Estimated Maximum Load:

Construed to mean the load stated in B.tu per hour or equivalent direct radiation that has been estimated by the purchaser to be the greatest or maximum load that the boiler will be called upon to carry.

Estimated Design Load:

The load, stated in B.tu per hour or equivalent direct radiation, as estimated by the purchaser for the conditions of inside and outside temperature for which the amount

of installed radiation was determined and is the sum of the heat emission of the radiation to be actually installed plus the allowance for the heat loss of the connecting piping plus the heat requirement for any apparatus requiring heat connected with the system. (A.S.H.V.E. Code of Minimum Requirements for the Heating and Ventilation of Buildings.)

Equivalent Direct Radiation:

Construed to mean the heat emission of 240 B.tu per sq. ft. of manufacturers' rated surface of direct steam radiation and 150 B.tu per hour per sq. ft. of manufacturers' rated surface of direct hot water radiation.

Grate Area:

As defined by the A.S.H.V.E. Code for Testing Low Pressure Steam Heating Solid Fuel Boilers.

Fuel Available in Hours:

Construed to mean the hours required to burn one available fuel charge. The available fuel is defined by the proposed A.S.H.V.E. Performance Test Code for Steam Heating Solid Fuel Boilers.

Over-All Efficiency:

As defined by the proposed A. S. H. V. E. Performance Test Code for Steam Heating Solid Fuel Boilers.

Priming:

The amount of free moisture carried by the dry saturated steam vapor delivered by the boiler stated as a percentage of the total weight of the sum of the dry saturated steam plus the free moisture delivered.

*Signed* L. A. Harding, *Chairman*,
R. V. Frost
F. C. Houghten
Continuing Committee on Codes for Testing and Rating Steam Heating Solid Fuel Boilers.

Before taking up the discussion of the report of the Boiler Code Continuing Committee, the next paper on the program, The Rating of Heating Boilers by Their Physical Characteristics, by C. E. Bronson, was presented. (Complete paper published in January, 1930, A. S. H. V. E. Journal.) In presenting the paper, Mr. Bronson explained that there was no intention of antagonizing the efforts of the Society's Committee endeavoring to arrive at a satisfactory solution of the boiler rating problem. He also explained that the *A. B. M. A.* had established a separate organization known as the *Steel Heating Boiler Institute,* the membership of which represents at least 95 per cent of all the steel heating boilers manufactured. He explained that the paper in question had to do with the rating code adopted by the *Steel Heating Boiler Institute,* based on physical characteristics of the boiler.

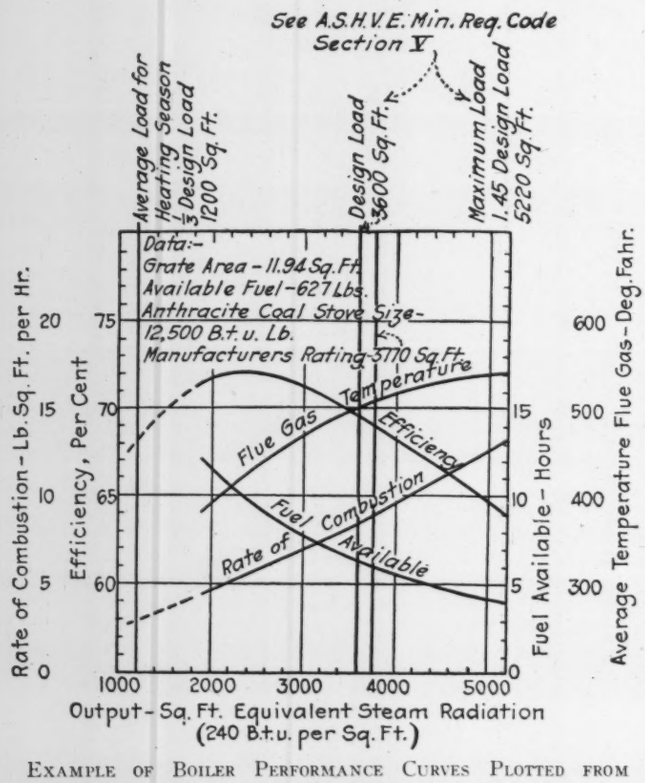
W. H. Carrier spoke at some length in support of the report of the committee. He pointed out that because of the similarity of steel boilers, they would lend themselves to conventional ratings more readily than cast-iron boilers, and raised the question as to whether there should be one rating for steel boilers and another for cast-iron boilers, and still another rating for some other type which might be developed. Mr. Carrier also discussed Mr. Bronson's paper and mentioned the 10 sq. ft. per horsepower rating of the old tubular boiler, which he thought greatly retarded the development of boilers. He called attention to the fact that, although at present the conventional designs of steel boilers are such as to permit of the establishment of relations between performance and dimensional data, it is possible that in the future this situation might change. He stressed the point that a code based on dimensions would apply only to present designs, and could not allow for changes which might take place in the future, and further stated that as long as a performance rating will answer the purpose, that it

SUGGESTED ARRANGEMENT OF PRESENTING OUTPUT DATA

| Boiler Designation | Output B.tu per Hr. / Output Eq. Steam Rad. Sq. Ft. / Output Eq. Water Rad. Sq. Ft. | 1255000 / 5220 / 8367 | **864,000 / 3,600 / 5,760** | 700000 / 2920 / 4667 | 563000 / 2355 / 3754 | 466000 / 1940 / 3106 |
|---|---|---|---|---|---|---|
| S-O-4 Grate area = 11.94 sq. ft. Available fuel holding capacity = 627 lb. | Fuel available, hours | 4 | **6.4** | 8 | 10 | 12 |
| | Rate of combustion, pounds per hour | 13.12 | **8.5** | 6.56 | 5.25 | 4.37 |
| | Efficiency, per cent | 64.0 | **69.6** | 71.5 | 72.0 | 71.5 |
| | Average draft, inches of water | 0.14 | **0.12** | 0.06 | 0.03 | 0.02 |
| | Average flue-gas temperature, degrees fahrenheit | 540 | **502** | 460 | 420 | 380 |
| | Inside dimension chimney, inches | 16x20 | **16x16** | 16x16 | 12x16 | 12x12 |
| | Min. height of chimney, feet | 55 | **50** | 45 | 45 | 45 |

(Statements as specified by the proposed revision of the code to accompany the rating tables)

It is recommended that the manufacturer call attention to the fact that if the boiler is to be able to satisfactorily develop the maximum listed output the corresponding size chimney must be employed.


See A.S.H.V.E. Min. Req. Code Section V
Average Load for Heating Season ⅓ Design Load 1200 Sq. Ft.
Design Load 3600 Sq. Ft.
Maximum Load 1.45 Design Load 5220 Sq. Ft.
Data:-
Grade Area - 11.94 Sq. Ft.
Available Fuel - 627 Lbs.
Anthracite Coal Stove Size-
12,500 B.t.u. Lb.
Manufacturers Rating 3770 Sq. Ft.
Temperature
Flue Gas
Efficiency
Fuel Combustion
Rate of
Available
Rate of Combustion - Lb. Sq. Ft. per Hr.
Efficiency, Per Cent
Fuel Available - Hours
Average Temperature Flue Gas - Deg. Fahr.
Output - Sq. Ft. Equivalent Steam Radiation
(240 B.t.u. per Sq. Ft.)

Example of Boiler Performance Curves Plotted from Boiler Performance Data Given in the Table

is a mistake in his opinion to consider a dimensional rating.

R. V. Frost said that the SOCIETY could not well afford to oppose the steel boiler manufacturers if they are ready as a unit to adopt a dimensional code which serves their trade relations and conditions. Furthermore, the SOCIETY cannot oppose the cast-iron manufacturers in any similar way, said Mr. Frost. He ventured the opinion that the performance method of rating has received the approval of practically all of the boiler manufacturers, there being only one or two who have not taken a definite stand in favor of this code. If the SOCIETY should adopt or approve a one-number rating which is bound up so intimately with the pricing and selling of a boiler, it would be going beyond the bounds of the function of the organization. Mr. Frost called attention to the fact that within the last year at least 50 per cent of the producing capacity of the steel boiler industry has taken up the performance method of rating, and that another manufacturer is to take it up next year, which will bring the number to 60 or 70 per cent of the total producing capacity in the steel boiler industry using the performance rating. Therefore, the SOCIETY could not very well do otherwise than offer them a uniform method of performance table coding, which is good reason for adopting the report as presented by the committee. Mr. Frost concluded by stating that the dimensional code had not satisfied the steel boiler industry as a whole, because the power boiler branch of the industry is at the present time endeavoring to develop some other method of rating.

In a written discussion of Mr. Bronson's paper by Prof. W. H. Severns of the University of Illinois, read by P. D. Close, the question was asked as to why the straight line of Fig. 1 was drawn to the upper plotted point to fix the capacity of a steel boiler at 14 sq. ft. of standard radiation per square foot of boiler heating surface, and also as to why the curve of Fig. 2, fixing the capacity per square foot of standard radiation for various grate areas was drawn above the average of the plotted point for the larger boiler.

H. M. Hart stated that as far as the SOCIETY is concerned, he could not see how any action, other than to accept the committee's recommendations, could be taken. He approved the report of the committee, with one exception, that the recommendations did not include a factor of safety. He stated that he had made comparisons, taking the design load as recommended by the code and as recommended by a boiler manufacturer, and that there was a uniform variation of from 40 to 45 per cent. He suggested that the report be accepted as given, with an additional factor of 20 per cent.

In order properly to bring the matter before the SOCIETY, J. D. Cassell moved that the code, as presented by the committee, be adopted.

R. M. Newcomb emphasized the difference of opinion which seems to exist between various factions interested in heating boilers. He voiced the opinion that the discussion indicated a lack of common meeting ground between the designers of cast-iron and steel heating boilers. He suggested that the code should not apply to steel heating boilers, and recommended that the report of the committee be limited to the smaller boilers and to cast-iron boilers, and that the dimensional code be accepted for the larger and the steel boilers.

C. W. Obert commended the report and expressed regret that some feature of the dimensional code was not worked in in some manner. He took issue with Mr. Carrier on the statement that the 10 sq. ft. basis of rating had retarded the development of the boiler industry, and stated that in his opinion this feature had enhanced the development of the steam boiler. He also drew attention to a reference made by Mr. Carrier relative to the dimensional basis of rating adopted originally by the automotive industry, and pointed out that this was necessitated by state license requirements. Mr. Obert related some of the experiences in connection with the development of the *A. S. M. E.* Boiler Code, showing how they have had to temporarily adopt the undesirable grate area basis of rating, which is still used in this code. The *A. S. M. E.* Boiler Code Committee has, since the adoption of the code on this basis, been seeking a dimensional rating basis which could be substituted for the undesirable grate area basis, and Mr. Obert stated that if a performance basis were accepted as proposed in the report under discussion, the question of dimensional rating would still be unsolved. He suggested that the motion be withdrawn and a motion passed to have the committee endeavor to incorporate a dimensional rating in the performance rating.

W. B. Russell asked to correct the impression that the steel heating boiler as it is manufactured and sold today is not a power boiler. He stated that the objection of the steel heating boiler manufacturers to the code proposed by the SOCIETY is that they want to maintain the conservative ratings of steel heating boilers that have been used with success over a period of years.

H. M. Hart again expressed his desire to have a factor of safety incorporated in this code for purposes of selection.

Lester Seelig expressed the desire that the SOCIETY go on record as favoring a dimensional code, because his experiences with performance codes had been disappointing.

In closing the discussion of the Boiler Code Committee Report, Mr. Harding concurred with the statement made by Mr. Carrier to the effect that there is a vast difference between the heat absorption value of shine and indirect surface, and cited an example to illustrate the point. He also agreed that there was considerable speculation as to what the trend in steel boiler design would be in the future.

Referring to the comment of Mr. Hart that the design load recommended by the code is not a safe load, Mr. Harding replied that a design load is not recommended in this code. Mr. Harding stated that performance curves could probably be obtained from some of the manufacturers, in answer to a question on this subject. He agreed that it would be desirable to correlate the recommended revision of the A. S. H. V. E. Rating Code and the *S. H. B. I.* Dimensional Rating, but, on account of the likelihood of the design of steel boilers changing, he deemed such a procedure unwise. Mr. Harding discussed the heating-up factors and agreed that there is a possibility that they should be increased.

Professor Rowley suggested that the motion before

the house be referred to the members by a letter ballot, which suggestion was made as an amendment to the original motion. This amendment was seconded and carried. The original motion, as amended, was also carried, and the Secretary was instructed to refer the matter to the membership at large, the result of the vote to be announced in the JOURNAL as soon as the result of the vote is obtained.

A progress report was submitted by E. K. Campbell, Chairman of the Committee on Garage Ventilation. Mr. Campbell called attention to the fact that the Code for the Heating and Ventilation of Garages had been adopted by the SOCIETY and the *National Fire Protection Association*. He stated that he had received a letter from the *N. F. P. A.* asking the committee to incorporate some additional information applying to small garages, and particularly to basement and sub-basement garages. The committee has been instructed by the Council to carry on some carbon monoxide investigations, which work is now being done under a co-operative agreement with Washington University, St. Louis, Mo. It is hoped that a complete report will be available in time for the June meeting. The report of the Committee on Natural Ventilation was submitted by Professor Emswiler, who stated that, as a tentative program for the future, the committee proposes, first, to continue with the study of the force of the wind as related to velocity and direction; second, to secure data on the variation of temperatures throughout large single story buildings; third, to investigate the movement of air in a multi-story office building where leakage is an important factor, and fourth, to study Weather Bureau records of wind and temperature in order to establish facts relative to directional and duration problems of wind of various intensities.

The paper entitled Some Studies of Airation of Garages by W. C. Randall and L. W. Leonhard, was presented by Mr. Randall. (Complete paper published in October, 1929, A. S. H. V. E. JOURNAL.) He stated that in studying the carbon monoxide content of garages, particularly after the investigation had proceeded for some time, and particularly after the conclusion of the investigation, the authors are convinced that the carbon monoxide content is very closely related to the heating load. Mr. Randall told of the various types of garages investigated.

Mr. Campbell said he thought that more attention should have been given to the so-called peak load periods in a garage, when a large number of cars are coming in and being put away. He concurred in the conclusion regarding the relationship between the carbon monoxide problem in a garage, and the heating-up problem, and also pointed out that open window ventilation is satisfactory only as long as windows can be opened with comfort; that when the comfort disappears the value of the ventilation goes with it. This, he averred, applies to garages as well, and that apparently the problem of garage ventilation begins when it becomes necessary to close windows because of lack of comfort.

W. H. Schulze of the Health Department of the City of Baltimore, told of the intention of starting some investigations relative to the amount of carbon monoxide in garages. It is the purpose of this proposed investigation to go into the effect of small doses of carbon monoxide rather than large doses—in other words, to investigate chronic carbon monoxide poisoning.

Andrew Vogel stated that industrial plants of today are changing in character, and that it is freely predicted that the industrial plant of the near future will consist largely of one building which will involve a serious problem of natural ventilation. He told of progress being made on natural illumination and hoped that the Natural Ventilation Committee would be able to do something comparable in the natural ventilation of buildings. Mr. Vogel cited an example of a large factory building. In this building the only means of ventilation is through the roof and the side walls, but, on account of the walls being at such a great distance from the central portion of the building, the only source of ventilation is through the roof. Hence, in many cases the air enters certain skylights and passes through the upper part of the building and leaves by other skylights. He also emphasized the fact that the problem of airation of garages is closely related to that of industrial plants where fumes of various types are given off, and that most states have codes requiring that fumes be exhausted by mechanical means, but that these codes generally do not approve other processes. He pointed out that these problems can be helped greatly by a thorough study of the laws of natural ventilation and therefore that co-operation is earnestly desired by the committee.

In concluding the discussion, Mr. Randall stated that further investigations should be made particularly with reference to situations involving more serious conditions than those reported in the investigation outlined in the paper. As to the method of producing the flow of air due to the forces of nature, Mr. Randall stated that he had collected some data which he proposes to present to the SOCIETY for approval, these data being of a practical rather than a scientific nature, but for all purposes were much more satisfactory than the material now available. H. M. Hart offered some suggestions in connection with the investigation of the number of cars in operation in garages of different types at the peak load. President Lewis called attention to the Society's Code of Minimum Requirements for the Ventilation of Garages for Fire Prevention, and explained some of the reasons for the Continuing Committee. E. C. Evans suggested for investigation a certain garage in Pittsburgh which is below the ground.

## Sixth Session—Thursday, January 30—2:30 P. M.

President Lewis read a communication from the *Institution of Heating and Ventilating Engineers* of Great Britain, and also another communication from A. Beaurienne.

The first paper scheduled for this session, entitled Pipe and Orifice Sizes for Small Gravity Circulated Hot Water Heating Systems, was presented by the author, Elmer G. Smith of Texas Agricultural and Mechanical College. (Complete paper published in February, 1930, A. S. H. V. E. JOURNAL.) Professor Smith called attention to the fact that the tables and data presented

in the paper should be considered preliminary, and that as soon as possible more complete information on the subject would be forthcoming.

President Lewis mentioned the fact that this paper was the result of co-operative research between our laboratory and the Texas A. and M. Engineering Experiment Station. He also called attention to the unusual amount of practical data contained in the paper.

Albert Buenger inquired about figuring the mean temperature of the radiation, and also wanted to know why the system was divided into four sections. He asked about series-connected radiators.

In reply to the question regarding the mean temperature in the radiators, Professor Smith stated that the purpose was to obtain the same mean temperature if possible, and cited an example to illustrate the point. Regarding series-connected radiators, as for example, in a basement, the author replied that he had not gone into this matter and has not contemplated doing so. He stated in substance that he would recommend a system similar to one devised by Prof. F. E. Giesecke in the latter's book on hot water heating. Professor Smith described the system on the blackboard.

President Lewis next called on H. M. Hart, who originally requested that the investigation under discussion be undertaken, and who accepted the Chairmanship of the Advisory Committee, under whose direction this work was done. He expressed gratitude that such good progress was being made on the involved problem of pipe sizes for hot water heating, and stated that to his knowledge this was the first time a set of hot-water pipe size tables had been compiled on a scientific basis. Although the work is far from completed, Mr. Hart stated, splendid progress has been made.

Mr. Nicholls drew attention to an overhead system, especially adapted to bungalows, and stated that the advantage of this system is that a uniform flow is obtained whether the radiator is 10 ft. or 100 ft. from the boiler.

E. B. Royer spoke highly of the tables prepared by Professor Smith, and expressed a preference for the method outlined in the paper, using former methods for check purposes. He told of the difficulties encountered with the overhead system, mentioned by a previous speaker, particularly with respect to the overhead main becoming dry, and thus stopping the circulation, causing the system to boil.

S. R. Lewis, Chairman of the Guide Publication Committee, was next called on by President Lewis.

### Report of Guide Publication Committee

The best report that the Guide Committee can make is that THE GUIDE will be waiting for you when you get home. The GUIDE 1930 is a new book. Almost every page has been changed in one way or another. There are several new chapters and many new tables. Despite all of this costly mechanical service, the cost of the GUIDE 1930 has been reduced about 45 cents from the cost of the GUIDE 1929. These figures cannot be taken too seriously, of course, because we have increased production and because the cost each year involves some hangover cost of the year previous, which was on a smaller production. We are climbing the peak all the time. We are printing about 3,000 more copies for 1930 than we did for 1929.

THE GUIDE is supposed from its name to be a leader through dark places and over stony roads. In this connection, the Guide Publication Committee feels that it would fail in its duty as a committee unless it suggests to its successor committee a few of its ideas for use of THE GUIDE.

The 1929 Committee has worked harmoniously. For the things in the present edition of THE GUIDE which are commendable, credit should be given to the staff of the SOCIETY—Messrs. Hutchinson, Close, Houghten and Korman and Miss O'Neil, who have worked most zealously without regard to overtime in building THE GUIDE. For the things in the present edition of THE GUIDE which are not pleasing to you, blame should be given to the Chairman of the Publication Committee, who has been given a free hand by the Committee and who can offer no alibis. The Chairman has confidence that he will hear of his mistakes from you and can only promise to correct and amend as may be practicable.

The staff of the SOCIETY has developed to a point where in the judgment of the Committee it may be practicable to make THE GUIDE a routine production of the staff, without any so-called Guide Publication Committee, just as we now handle the JOURNAL, under the general supervision of the Publication Committee of the Council. The Guide Publication Committee suggests further that THE GUIDE in its function as a leader should promote and suggest improvement in nomenclature. The trade names of Heating and Ventilating Engineers are cumbersome and archaic. Many terms, such, for instance, as unit heater, vacuum valve, radiator, are misleading and cumbersome, and the present committee could develop improved trade nomenclature.

The Guide Publication Committee suggests finally that the term "square foot" and the term "horse power" be deleted from future editions of THE GUIDE, or at least that where "square feet" is used in pipe sizes and other tables that heat units be given in the parallel column, during the transition period, until gradually we can get rid of these old terms.

THE GUIDE is the product of the service of many generous people, most of them not even being members of the SOCIETY. The Publication Committee wishes to acknowledge its indebtedness to these friends.

The next item of business related to U. S. Public Health Service Bulletin, F 36, concerning school ventilation. This matter was brought before the Council at the meeting in Pittsburgh in connection with the Research Laboratory Open House, when it was suggested that the President, accompanied by a number of eminent engineers, confer with the Surgeon-General in Washington, regarding this bulletin, the substance of which was to the effect that open window ventilation is sufficient for modern school buildings.

A splendid reception was extended the committee by the Surgeon-General, who admitted that it was a great mistake for this bulletin to have been issued. He agreed to issue another bulletin correcting the statement made in the original bulletin, if prepared in proper form by our SOCIETY. Such a bulletin was prepared, and after some time Secretary A. V. Hutchinson conferred with Dr. Thompson, Assistant to the Surgeon-General, and was informed that the bulletin was not entirely satisfactory in the form in which it had been submitted. Several conferences were held, the most recent being on January 28, 1930, between Dr. Thompson, W. H. Carrier and Prof. A. C. Willard.

Mr. Carrier then gave the details of this conference, which he stated was not as long as they would have liked. Dr. Thompson submitted an article which he stated his Department would be willing to publish. Some of it was quite acceptable, but other parts of it were

not, as material was included that was not supported by facts.

The U. S. Public Health Service takes the position that while they are perfectly willing to admit they were in error in making statements which had not been proved, they are not going to make the same error again. Any statements made must be susceptible of positive proof by conclusive data before they will be accepted. It was pointed out by Mr. Carrier that the data published by the New York State Commission on Ventilation on which the original bulletin of the U. S. Public Health Service was based are not conclusive, and therefore the subject is still controversial. The claim by the open-window advocates that such ventilation is less costly was also questioned by Mr. Carrier.

The important thing, Mr. Carrier said, was to correct the impression that had been so generally broadcast, that window ventilation means that it is only necessary to open a window to obtain the desired result. The open window advocate actually has in mind a well-defined plan involving some engineering as well as considerable expense, first, to obtain proper air distribution from the window, and second, to provide ample vents for each room to remove the air by gravity.

Mr. Carrier pointed out that it is possible to show that no matter how window ventilation is arranged, the lee side of the building will not get air from out-of-doors. He emphasized the fact that there are certain conditions for which mechanical ventilation has a decided advantage over window ventilation on any basis of air change, particularly in connection with large schools. He stated that this matter was in the hands of Professor Willard.

It has been claimed by the open-window advocates that it is necessary to overheat with mechanical ventilation and that humidification is of no value. It has been proved, Mr. Carrier stated, that it is necessary to have a higher temperature with unconditioned ventilation, such as window ventilation than with conditioned mechanical ventilation, which seems to refute the claims of the open-window people. Mr. Carrier stated that the primary object was to present the facts as far as they are obtainable, and can be verified, in as brief a form as possible. The U. S. Public Health Service is anxious to find out the facts independently for themselves, and will welcome the co-operation of our Research Laboratory, so far as suggesting methods by which the investigation shall be conducted. Mr. Carrier stated that all SOCIETY members are interested in the truth.

President Lewis called attention to the fact that the present controversy has to do with school ventilation, and bearing in mind this fact, it seems somewhat strange that one department of the U. S. Government would make a statement to the effect that school children need only the open window method of ventilation, while at the same time the government is spending millions to condition the Halls of Congress for the Congressmen. He emphasized the inconsistency of these two facts.

In presenting the next paper, entitled Panel Warming (see January, 1930, A. S. H. V. E. JOURNAL), the author, L. J. Fowler, of London, called attention to the fact that it is possible to feel comfortable in a room even though the temperature of the air is only 50 deg., if the surrounding walls and ceiling are at a temperature of about 75 deg. This, Mr. Fowler pointed out, is the principle of the panel system.

In the discussion of this paper, F. I. Raymond asked why the temperature differential between floor and ceiling was so small. R. S. Franklin inquired about the method of calculation for determining the proper amount of coil surface, and also wanted to know whether or not it is true that panel warming is not applicable to countries with low temperatures. F. N. Torrence inquired as to whether insulation was placed between the coils and the walls when they are used on outside walls. Mr. Bruce wanted to know whether the friction loss through the piping, due to the return bend construction, would make it necessary to use a pump running under a very high head, or whether the manifold system would be better. Mr. Saunders inquired as to whether there was any noticeable difference in the temperature required in heating by radiation, from our usual method of heating.

W. H. Carrier spoke about the use of this system for cooling in certain climates. He agreed that the radiating effect of colder surfaces, where the dew-point temperature is not particularly high, would be quite effective, but in localities where the dew-point temperature is often 75 F or higher, it would not be possible to obtain much cooling effect without getting condensation on the surfaces. Hence, he did not believe the proposition of cooling was a very inviting field for investigation.

As to the small temperature differential between floor and ceiling, Mr. Fowler explained that this was due to the fact that if the air in the room is still, that immediately in contact with the panel gets warm, but inasmuch as air is a poor conductor of heat, it requires considerable time for the heat to reach the lowest part of the room. If, however, convection takes place owing to windows or cold wall surfaces, then the temperature differential is very materially increased. Mr. Fowler pointed out that the temperature in a room is remarkably constant, except for a layer of air 2 or 3 in. thick under the panel.

The same procedure is followed in the method of calculation as for other types of heating system, Mr. Fowler declared, excepting that a reduced air change is allowed. The author stated that the drop in head through a panel system is between 3 and 4 ft. of water. As to the application of this system to countries in which the temperatures are very low, the speaker stated that they had had no experience excepting the British Embassy job in Washington. He stated that temperatures as low as 18 F were encountered in England last year, which means a temperature difference of 50 F. He could see no reason why this type of heating system should not be effective for a base temperature 20 F lower than that encountered in England.

As to the method of testing the pipes after they are in place, it was stated that a mixture containing a certain percentage of glycerine is used, one riser being tested at a time, and the liquid being used over and over again. Mr. Fowler expressed some doubt, however, as to whether this could be done at zero temperatures. When the coils are installed in the outside walls, the situation is the same as when they are installed in top floor ceilings, Mr. Fowler explained, and a layer of

insulation is used in back of them. In answer to Mr. Carrier's remarks on cooling, the speaker advised that if the surface is not cooled more than 2 deg. below the dew-point temperature, condensation does not take place, because the convection currents prevent the precipitation of moisture. In reply, Mr. Carrier emphasized the fact that the dew-point temperatures in London are considerably lower than they are in New York, in the summer time. Mr. Fowler explained that an advisory company is being organized in America for developing the panel system.

After expressing appreciation for Mr. Fowler's efforts in behalf of the SOCIETY in presenting this paper, President Lewis introduced the next speaker, F. I. Raymond, who presented the paper entitled Development of a Method for Heat Regulation, by Raymond and Lambert (to appear later). In the presentation of this paper, Mr. Raymond stated that automatic heat control should provide a comfortable temperature in all parts of a building at all times, and should reduce operating costs.

T. F. McCoy wanted to know whether or not it was necessary to use orifices with this system to produce an even distribution of heat. B. W. Wilson asked how this system could be hooked up with a thermostat. I. S. Dane inquired as to whether it was possible to use extended surface radiation in one room and cast-iron radiation in another room, and obtain even control. H. M. Hart expressed the opinion that this method of heat regulation has great possibility for eliminating some of the difficulties experienced with oil and gas-fired installations. S. R. Lewis called attention to the folly of installing a vapor system and endeavoring to control an oil burner with a thermostat in the living room. Mr. Gatzenberger of Philadelphia wanted to know if there was any limitation on the length of capillary tubing. Mr. Acton of New York told of several installations in which highly commendable results were obtained.

Mr. Raymond stated that the orifice is of great benefit, and that a one-pipe steam heating system can be controlled quite satisfactorily due to an inherent balancing effect that is present in a one-pipe system. Mr. Raymond pointed out that orifices are especially important in the morning when the system is warming up. He explained that the connections to the thermostat in the case of an electric system are made just as they are to an aquastat or to a pressure control. In reply to the question submitted by Mr. Dane, the speaker stated that this method of heat regulation works very satisfactorily on a combination of extended surface and cast-iron radiation, because steam is always present in the steam main.

Mr. Raymond agreed with S. R. Lewis that thermostatic control of a vapor system is not warranted. Mr. Raymond stated that the length of tube was about 30 ft., and that the nature of the instrument is described in the paper. As to the effects of the temperature surrounding the capillary tubing, it was explained that it is assumed that the capillary tubing has the same temperature as the instrument, and there is a compensation in the instrument which takes care of the difference in temperature. President Lewis suggested that Mr. Raymond submit further experiences in connection with this method of control at a later date.

Before the close of the session, Professor Giesecke expressed regret at not being present when Professor Smith's paper was presented, and told of the splendid results being obtained by Professor Smith in connection with the experimental work relating to the determination of pipe and orifice sizes for hot water heating systems.

## Seventh Session—Friday, January 31—9:30 A. M.

A paper entitled Friction Losses and Observed Static Pressures in a Domestic Fan Furnace Heating System, by Prof. A. C. Willard and Prof. A. P. Kratz, was presented by Professor Kratz. (Complete paper published in December, 1929, A. S. H. V. E. JOURNAL.) President Lewis thanked Professor Kratz for the many papers of high calibre he has presented before the SOCIETY. In presenting this paper, Professor Kratz called attention to the fact that the use of fans for warm air systems was becoming quite common, but that these fans are installed more or less indiscriminately without taking account of the static pressures against which they are required to operate. It is apparent, Professor Kratz stated, that an intelligent selection of such fans is impossible without some data as to the static pressure.

C. C. Hartpence discussed the subject covered by this paper at some length. He stated that the air change with a gravity system requires about 30 minutes, whereas with fan circulation the air change usually requires from 15 to 20 minutes, but that air changes as often as 10 minutes are desirable. He discussed the problem of distribution of sound, and called attention to the possibility of grief, if this problem were not properly provided for.

J. C. Miles pointed out the rapid growth of the fan furnace system of heating in the past few years, and emphasized the importance of intelligent design of this type of heating system. Mr. Miles also read a written discussion of this paper.

In concluding the discussion, Professor Kratz called attention to the fact that most of the troubles referred to by Mr. Hartpence are brought about by failure to take into consideration the fact that the principles for designing a gravity installation are diametrically opposed to the principles for designing a fan furnace system. In a gravity system, Professor Kratz stated, the fans must be sufficiently large to provide the proper amount of heat. On the other hand, in a fan system, the pipes must be proportioned according to the resistance. Hence, if a fan is installed in a system designed for gravity circulation, the air takes the path of least resistance, which is necessarily through the first floor, and consequently, the first floor is overheated, and the system is unbalanced. It was pointed out that if a system is designed for fan circulation, it is necessary to operate the fan continuously. As to stratification, the speaker advised that they had obtained no evidence that fan circulation had improved the condition.

A written closure on Mr. Miles' discussion was read by Professor Kratz. He stated that the objection that the fan system as used was the worst possible because it was installed in the best possible gravity system, bears out the author's statement that a properly designed and correctly installed gravity system does not need a fan.

The authors agreed that the suggestion that intermittent operation might be an inherent advantage in utilizing frequent occurrence of the peaks in heat delivery induced by the fan is worthy of attention. The authors stated that the introductory remarks in the paper were generalizations rather than conclusions drawn solely from the material in the paper, and are based on their experience with, and data taken from, tests on the fan installation in the research residence, and on fundamental principles of air flow.

W. T. Jones, Chairman of the Finance Committee, next presented amendments to the By-Laws for consideration. These amendments had been submitted to the SOCIETY through the mail and have two principal objects, to safeguard the funds of the SOCIETY, and to segregate under one heading those items which apply to the handling of the funds of the SOCIETY. The proposed amendments were read by Mr. Jones, and he also called attention to Article VIII, Section 1, dealing with the employment of a research committee consisting of Council members. Inasmuch as this committee does not exist and has not been appointed for several years, and would interfere with the work of the Research Laboratory, as this matter is taken care of under the election by the SOCIETY of the Research Committee, it was suggested that it be eliminated. It was moved by Mr. Jones that these amendments to the By-Laws be adopted, and seconded and carried.

## AMENDMENTS TO THE BY-LAWS

In accordance with the provision of the By-Laws relating to Amendments, the following changes were voted upon at the Annual Meeting 1930 held at the Benjamin Franklin Hotel, Philadelphia, Pa., January 28 to 31, 1930, and unanimously adopted.

### BY-LAWS

(1) **Article XIII—Amendments:** to become Article XIV.

(2) **Article XIII—Funds.**

***Section 1.*** All funds and moneys shall be received, deposited, invested and disbursed under the direction of the Council.

***Section 2.*** When so directed by the Council, the Chairman of the Finance Committee, shall invest such portion of any funds of the Society as determined by the Council in securities legal for the investment of funds of savings banks of the State of New York. All investments shall be approved by the Council.

***Section 3.*** Any bequest or gift to the Society which the donor shall designate to be used for a specific purpose shall, after acceptance by the Council, be deposited or invested in the manner provided by Sections 1 and 2, and the income or principal, as designated by the donor, used for the specific purpose designated.

***Section 4.*** An endowment fund for research and such other purposes devoted to the art of heating and ventilating as may be determined by the Council shall be established. The interest or income from this fund shall be used each year as shall be determined by the Council. The principal shall remain intact and shall be deposited in banks or invested in securities legal for the investment of funds of savings banks of the State of New York, as determined by the Council in the manner provided by Sections 1 and 2.

***Section 5.*** At the beginning of each year the Finance Committee shall present to the Council a budget of estimated income and expenditures for the current year, which after approval by the Council shall govern the expenditure of Society funds for that year. Any proposed expenditure of Society funds outside of the approved budget shall be approved by the Council before the expenditure is made.

***Section 6.*** Any money due the Society shall be collected by the Secretary, who shall enter all receipts in the books of the Society and deposit same to the Treasurer's account. The Secretary shall receive all bills against the Society, and shall present them for audit and approval to the Chairman of the Finance Committee. The approved bills shall be referred to the Treasurer which officer if he also approves the bills shall draw and sign a check payable to the account of AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS for the total amount of the approved bills. The Treasurer shall present the approved bills with the check to the President of the Society for his examination. After approval of the bills by the President, that officer shall countersign the check in payment thereof, which check shall be deposited to the account of American Society of Heating and Ventilating Engineers and known as the Secretary's account. The Secretary shall promptly draw against this account in settlement of the approved bills. The Secretary shall have the authority to pay salaries, traveling expenses and petty cash in accordance with the budget. In case of disability or absence of the Treasurer, the Chairman of the Finance Committee is authorized to sign checks. He shall give bond in the same manner as provided for the Treasurer.

***Section 7.*** After December 31st, and before the annual meeting of the Society in January, the accounts of the Society shall be audited by a certified public accountant, selected by the Council at its last meeting in the calendar year. The auditor's report shall be presented at the annual meeting of the Society by the Chairman of the Finance Committee.

***Section 8.*** The funds of the Research Laboratory shall be handled separately from the funds of the Society, in accordance with the by-laws of the Society and the regulations which govern the Research Laboratory.

(3) **Article VII, *Section 4,*** reads as follows:

The Treasurer shall have the custody of all the funds of the Society, and shall deposit them to the credit of the Society in such bank or depository as the Council may designate, and he shall disburse the same as provided in Article VIII, Section 3. He shall enter regularly in books of the Society to be kept by him for the purpose, full and accurate account of all moneys received and disbursed for the Society. He shall at all reasonable times exhibit his books and accounts to any member of the Council, and shall perform all duties incident to the office of the Treasurer, subject to the control of the Council. He shall give a bond in a penal sum and with a surety or sureties approved by the Council, for the faithful performance of his duties as Treasurer. If a surety company bond is furnished the premiums therefor shall be paid by the Society.

To be amended to read as follows:

**The Treasurer shall have the custody of all the funds of the Society, as provided in Article XIII. He shall at all reasonable times exhibit his books and accounts to any member of the Council, and shall perform all duties incident to the office of the Treasurer, subject to the control of the Council. He shall give a bond in a penal sum and with a surety or sureties approved by the Council, for the faithful performance of his duties as Treasurer. If a surety company bond is furnished the premiums therefore shall be paid by the Society.**

(4) Repeal ***Section 7,*** **Article VI;** ***Section 5,*** **Article VII;** ***Section 3,*** **Article VIII;** which are covered in the proposed **Article XIII.**

**Article VI, *Section 7,*** which reads as follows:

The Council shall designate the bank or depository in which the funds of the Society shall be deposited and shall by appropriate resolutions designate the purpose for which the funds may be withdrawn and authorize such withdrawal. In case of disability or absence of the Treasurer the Chairman of the Finance Committee is authorized to sign checks. He shall give bond in the same manner as provided for the Treasurer.

**Article VII, *Section 5,*** which reads as follows:

The accounts of the Treasurer and the books of the Society shall be audited annually by a certified public accountant selected by the Council at least thirty (30) days before the close of the fiscal year.

**Article VIII, *Section 3,*** which reads as follows:

The Finance Committee shall prepare an annual budget of expenditures for the Society and shall pass upon and approve in writing all expenditures authorized by the Council. No expenditures are to be made by the Secretary, except for salaries, traveling expenses and petty cash, unless authorized by the Chairman of the Finance Committee, on forms provided for that purpose.

(5) Amend **Article VIII, *Section 1,*** as follows:

Eliminate item "e" Research Committee.

Amend **Article IX, *Section 1,*** by substituting for the words: **Article VIII, *Section 3,*** the words: **Article XIII, *Section 6.***

The next item of business was the installation of the new officers, and the President-Elect, L. A. Harding, was escorted to the chair by Past-President J. I. Lyle. Mr. Harding promised to extend his best efforts in carrying on the work of the SOCIETY for the coming year, and said he would inaugurate as many new ideas as

possible. He called attention to the tremendous rate at which the SOCIETY is progressing, and realized the work ahead of him. He expressed the hope that he would be able to carry on the good work.

Willis H. Carrier, First Vice-President-Elect, was next escorted to the platform by Past-President H. M. Hart. Mr. Carrier indicated his willingness to extend all possible assistance to the incoming President, Mr. Harding, and confessed that the task would be somewhat difficult to maintain the record that had been established. He admitted, however, that the work would be lightened somewhat by the fact that the program is so well organized.

After Second Vice-President Rowley and the four new Council members were introduced, President Lewis called on C. H. Roth, Vice-President and General Manager for the International Exposition, who cited some interesting facts regarding the Exposition. He mentioned the fact that the visitors had come from practically every State in the Union, and from many foreign countries. He also told of the experience of one exhibitor who had made a practice of meeting every foreign-looking person passing his booth. This particular exhibitor had received orders which indicated that a substantial amount of foreign business would be obtained from these various individuals. Mr. Roth pointed out that in many cases our foreign visitors are rather retiring, and suggested that an effort be made by the exhibitors to be more friendly with them.

Figures as to the attendance were quoted, and President Lewis called attention to the fact that the check tendered by Mr. Roth in the amount of $5,000 was the first payment on account, and that probably there would be several hundred dollars more in the amount allotted to the Research Fund of the SOCIETY.

The next speaker was L. L. Lewis, who presented the paper Air Conditioning the Halls of Congress, by Mr. Lewis and A. E. Stacey. (Complete paper published in December, 1929, A. S. H. V. E. JOURNAL.) The speaker thanked President Lewis for the assuring remarks made regarding the value of this installation, and of the paper, because, as the author stated, he was somewhat skeptical about the presentation of this paper without also presenting data relating thereto. Mr. Carrier discussed the ventilating system originally installed, which had been in use since it was installed in the nineties. The air entered in a plenum underneath the floor of the House and Senate, and in actual operation it was found that a temperature not lower than 68 deg. could be introduced, because otherwise the Senators would complain. Theoretically the system was ideal, but actually on account of the fact that the entering air temperatures were limited, the system was not satisfactory. Furthermore, the system had no provision for air cleaning. Mr. Carrier attributed a great deal of the success of the present installation to the fact that overhead distribution had been used. He also called attention to the fact that the air is thoroughly cleaned.

Mr. Harding complimented the authors on the character of the paper, and expressed the hope that some time in the future another paper on this subject would be presented giving more statistical data which would be of interest to the SOCIETY.

The next paper on the program, Tests of Disc and Propeller Fans, by Prof. A. I. Brown, was presented by title in the absence of Professor Brown. (Complete paper published in February, 1930, A. S. H. V. E. JOURNAL.) A discussion by H. M. Hagen of Boston was also presented by title, owing to Mr. Hagen's absence.

The President next called for unfinished business, and resolutions presented by John F. Hale were adopted.

*RESOLVED* That the SOCIETY express its hearty congratulations to those who make possible the remarkable success of the heating and ventilating exposition.

*RESOLVED* That the SOCIETY express its appreciation for the splendid cooperation they have received from the representatives of the press.

*RESOLVED* That we extend to the management of The Benjamin Franklin Hotel, our thanks and appreciation for the excellent service rendered and the pleasant accommodations provided.

*RESOLVED* That it is the sense of this meeting that the general arrangement committee involving program, transportation, banquet and the entertainment of our ladies has overlooked nothing, and we wish to extend to them our appreciation for the graceful manner in which our interests and happiness have been anticipated.

W. A. Rowe presented a resolution extending thanks to the Benjamin Franklin Hotel for the excellent service rendered, which was adopted.

Attention was called to the recent death of John A. Quinn, President of the *National Association of Master Plumbers*, and a resolution expressing the sincere sympathy of the SOCIETY to the members of his family was presented by H. G. Black, and adopted.

After turning the gavel over to the new President, L. A. Harding, the meeting was adjourned.

## *A. S. M. E.* Anniversary Celebration

*The American Society of Mechanical Engineers* will celebrate its Fiftieth Anniversary on April 5, 6, 7, 8 and 9, 1930. The celebration will take place in New York, at the headquarters of the *A. S. M. E.* and at the offices of American Machinist, where the preliminary meeting of the organizers of the Society was held on February 16, 1880; and in Washington, D. C., the place that is fittingly in accord with the national and international character of the convocation.

The world's leading scientific and engineering societies and educational institutions have been invited to send two delegates each to the celebration. Similar invitations have been extended to the leading trade associations and trade schools of the United States.

This celebration will review the past 50 years of engineering achievements, will bring together the world's outstanding men in engineering, and will aim to create bonds between nations on the basis of engineering accomplishments.

On this occasion a series of sixteen papers will be presented, each summarizing and evaluating the influence of engineering upon cultural, social, economic, and political life. Each will also visualize the future of the engineer's place in the promotion of the common welfare in one of sixteen selected geographical divisions of the world. The authors of these sixteen monographs will be distinguished engineers in the sections of the world of which they write and each will be awarded a Fiftieth Anniversary Medal.

Simultaneously with the Anniversary Dinner on April 8, Local Sections of the Society will hold meetings as part of the celebration of the Fiftieth Anniversary of the *A. S. M. E.* At these meetings phonograph records containing messages presented in Washington will be available, and in other ways such gatherings will be closely related to the Washington celebration.

# Entertainment at Philadelphia Meeting

No stone was left unturned to make the entertainment features of the Annual Meeting at Philadelphia, January 28-31, 1930, outstanding in the history of SOCIETY meetings, and memorable in every respect. Nothing more could have been desired, and all departed with a feeling that the Committee had anticipated every possible wish of the unprecedented number of guests.

The Committee on Arrangements of the Philadelphia Chapter, consisted of R. C. Bolsinger, *General Chairman;* J. D. Cassell, *Honorary Chairman* and Toastmaster at the Banquet; Lee Nusbaum, *Finance Chairman;* M. C. Gillett, *Ladies' Entertainment Chairman;* A. J. Nesbitt, *Banquet Chairman;* F. D. Mensing, *Publicity and Transportation Chairman.* The hostesses were Mrs. Thornton Lewis, Mrs. M. C. Gillett, Mrs. W. G. Culbert, Mrs. M. F. Blankin, Mrs. R. C. Bolsinger, Mrs. C. G. Binder, Miss Edgar, Mrs. A. H. MacDade, Miss Theodora Jellett, Mrs. William Miller, Mrs. A. J. Nesbitt, Mrs. Lee Nusbaum, Mrs. H. J. Walther and Mrs. W. Webster, Jr.

A tour of inspection of Philadelphia manufacturing plants was made on Monday, Jan. 27, and visitors inspected plants of the Brown Instrument Company, Frost Research Laboratory, John J. Nesbitt, Inc., Schutte & Koerting Co., Warren-Webster & Co., and York Heating & Ventilating Corp.

An informal tea for the ladies on Monday afternoon afforded the opportunity of renewing former acquaintances and meeting new friends. Dinner was served in the evening to the ladies at the Mari-Ann, an unique restaurant located in the basement of an apartment building. After dinner the ladies were taken in buses to a theater where a splendid program was enjoyed. After the theater party, a buffet supper was served in the hotel, and moving pictures of former meetings were shown.

A bridge party for the ladies was held on Tuesday afternoon, and a number of handsome gifts awarded during the tea which was served at the Benjamin Franklin Hotel immediately following the bridge party.

On Wednesday the ladies had the choice of a trip to Valley Forge, where luncheon was served, or a luncheon at the Benjamin Franklin Hotel, followed by a matinee at "New Moon." The usual Past-Presidents' dinner was given on Wednesday evening, and was attended by 14 members of this select group. The wives of past presidents were entertained at dinner at the Manufacturers Club by Mrs. Thornton Lewis. The entertainment features Thursday started with a Breakfast Bridge at the hotel at 10:30 a. m. Many beautiful gifts were awarded to the winners.

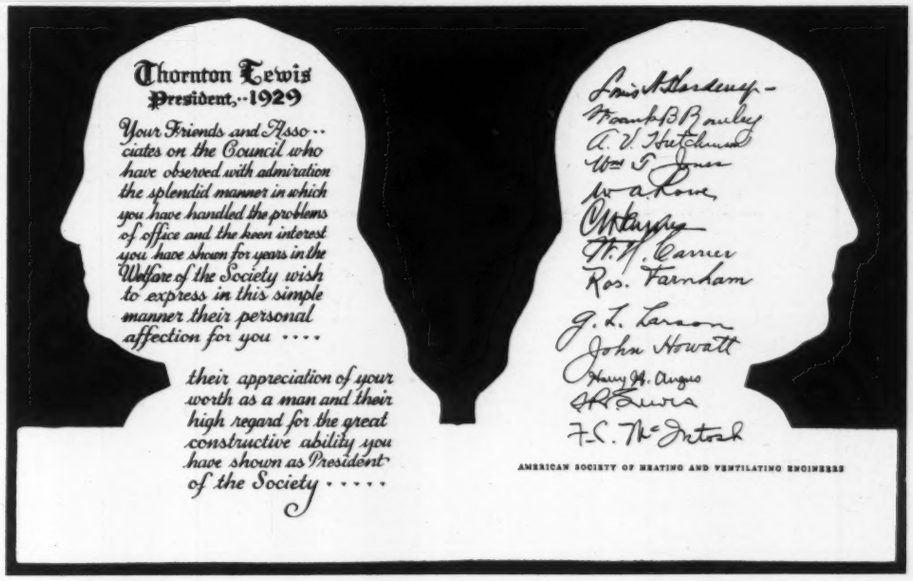
The climax to the festivities took the form of the annual banquet held on Thursday evening. Toastmaster J. D. Cassell called attention to the number of young men in the organization who are taking active part in the SOCIETY, and stated that in the early days it was unusual even for a young man to present a paper or to address a convention. Mr. Cassell also spoke regarding the Exposition and stated that in his opinion it was the greatest affair of its kind ever held. He also stated that the Exposition had attracted large crowds in spite of the fact that the exhibitors had not made a practice of distributing novelties and trinkets. The sights, he stated, made him feel as though he had never been in the heating and ventilating business, and that the Exposition had far exceeded his expectations.

Mr. Cassell then introduced Cecil Farrar, Chairman of the Committee on Increase of Membership, who so admirably performed the task placed on him. After a few appropriate remarks, Mr. Farrar announced that G. H. Giguere of the Detroit Chapter was entitled to first place for having secured the largest number of applications for membership, which was 49. The second highest was E. C. Evans of the Pittsburgh Chapter, who secured 29 members. W. G. Hillen of the New York Chapter was third, with a total of 26 applications secured, and W. R. Blackhall of the Toronto Chapter, fourth. Robert Arnold of Philadelphia and W. P. McFarland of Chicago, were fifth and sixth, respectively. A banner was also awarded to the Chapter securing the largest number of new members, and the Michigan Chapter was the recipient of this emblem, largely as the result of Mr. Giguere's efforts.

Toastmaster Cassell then introduced H. P. Gant, to whom he referred as "horsepower," not only because of the initials H. P., but because of his dynamic personality. Mr. Gant related the experiences of two young men who started out 20 years ago in New York, later moving to Philadelphia where they became associated in business. It developed that these two individuals were none other than Thornton Lewis, President, and H. P. Gant, the speaker and Past-President, referred to in this narrative. Mr. Gant called attention to his high regard for his intimate friend and business associate, President Thornton Lewis, and he then conferred the Past President's emblem on his colleague.

Prior to the response by President Lewis, Toastmaster Cassell read a memento presented by the Council, expressing deep affection and great admiration for the splendid manner in which Mr. Lewis handled the duties of the office he was about to relinquish, and for the keen interest shown in the welfare of the SOCIETY for many years. In reply, Mr. Lewis stated that he was deeply touched by the words of appreciation that had been conferred

MEMBERS AND GUESTS ASSEMBLED AT 36TH ANNUAL BANQUET, BENJAMIN FRANKLIN HOTEL, JANUARY 30, 1930.


Thornton Lewis
President,--1929
Your Friends and Associates on the Council who have observed with admiration the splendid manner in which you have handled the problems of office and the keen interest you have shown for years in the Welfare of the Society wish to express in this simple manner their personal affection for you ····
their appreciation of your worth as a man and their high regard for the great constructive ability you have shown as President of the Society ·····
AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

MEMENTO PRESENTED TO PAST-PRESIDENT THORNTON LEWIS BY THE COUNCIL.

upon him, and stated that it was difficult at a time like this for a man adequately to convey his feeling in the matter.

President Lewis called attention to a sum of $20,000 which had been appropriated by the Council at the last meeting for the endowment fund. He pointed out that the registration had more than doubled that of any previous meeting, and then introduced A. C. Edgar of Philadelphia, who had not missed a single meeting since the SOCIETY was organized 36 years ago.

The speaker referred to the agreement between the SOCIETY and the managers of the *International Heating and Ventilating Exposition*, and related some of the circumstances which led up to the Exposition. He told of the original plan which called for a stipulated percentage allowance from that organization regardless of the financial success of the undertaking, and pointed out that they had not kept their promise—that is, that they had doubled the percentage originally agreed to by them. President Lewis commended highly the work of Mr. Roth and his associates.

L. A. Harding, the incoming President, gave a clever mirth-inspiring speech. He stated that he was not insensible to the great honor conferred upon him, and that while he was not as tall and handsome as many of the Past-Presidents, he would endeavor to administer the affairs of the SOCIETY to the best of his ability. In closing he stated "it is my hope and earnest wish that my coefficient of receptibility will be high during my office, and that my diffusion vanes will always be so adjusted that I will never give any one a pain in the neck."

The next speaker was Harry Black, president of the Philadelphia Chapter, who made a few remarks on behalf of the splendid accomplishments of R. C. Bolsinger, General Chairman of the Committee on Arrangements for the meeting, to whom he presented a token of the esteem and appreciation of the Philadelphia Chapter for Mr. Bolsinger's efforts. In response, Mr. Bolsinger stated that, while he appreciated the kind remarks of Mr. Black and also appreciated the gift he felt that he was not entitled to it because it was the committee who did most of the work, and that all he did was to make a few suggestions. Mr. Bolsinger also expressed appreciation for the cooperation of the guests.

Toastmaster Cassell next introduced Albert Buenger of the Minnesota Chapter, who extended an invitation to come to Minnesota June 24-27 for the Semi-Annual Meeting. Mr. Buenger outlined the items of interest to those who come to this meeting, and stated that the committee on arrangements would put forth every effort to make the occasion worth while to all who attend.

President Lewis next revealed the details of a medal of award to be conferred each year on some member of the A. S. H. V. E. in recognition of work done for service performed in the field of heating, ventilating or air conditioning. For this purpose Mr. Lewis contributed the sum of $1,000, and suggested that the first award of this medal be made to the member of the SOCIETY not more than 30 years of age who presents the best technical paper before the SOCIETY during the year 1930. The name of this award is to be the F. Paul Anderson Medal in honor of Dean Anderson of the University of Kentucky, and Past-President of the SOCIETY, who, President Lewis stated, has not only greatly influenced our art, but has trained more men for this profession than any other man in America, or perhaps, in the world.

After the banquet, the guests enjoyed a night at Monte Carlo, for which purpose each was provided with a substantial number of "1000 bucks." True to form, however, the croupiers soon had all the "money" of the guests. A dance orchestra provided music for dancing until the small hours of the morning.

The final entertainment feature was a farewell luncheon served to the ladies in the Benjamin Franklin Hotel, Friday noon.

## A Correction

The author of the paper Tests of Disc and Propeller Fans, appearing in the February issue, on page 157, calls attention to a correction of the scale of the ordinate of pressure and horsepower in Chart Fig. 1, page 162, where the values should be 0.1, 0.2, 0.3 and 0.4. He also points out that any comparison of the values in Table 3 would immediately reveal the discrepancy in the original publication.

## Henry Adams Inc. Announced

The organization of the late Henry Adams, consulting mechanical engineer, announces that it will continue its engineering practice as Henry Adams Inc., with the same staff of assistants heretofore associated with Mr. Adams. The assistants, E. H. Adams, C. T. Adams and H. W. Glaser, have been joined by Edward L. Crosby, mechanical engineer.

A VIEW OF A PORTION OF ONE SECTION OF THE INTERNATIONAL HEATING AND VENTILATING EXPOSITION IN THE COMMERCIAL MUSEUM, PHILADELPHIA, JANUARY 27-31, 1930. TAKEN SHORTLY AFTER THE DOORS HAD BEEN OPENED

# First International Heating and Ventilating Exposition

RESPLENDENT with examples of the genius of the profession, the First International Heating and Ventilating Exposition, which was housed in the Commercial Museum, Philadelphia, January 27-31, 1930, was proclaimed a stupendous success by all who attended. The exposition was held concurrently with the 36th Annual Meeting of the SOCIETY at the Benjamin Franklin Hotel, and was marked by the unusual quality of the 280 exhibits, which were outstanding not only as to the character of the materials and equipment shown, but also because of the attractive manner in which the displays were arranged.

The great expanse of floor space was filled with all manner of devices for inducing human comfort and reducing the inconveniences that have, for years, been associated with heating and ventilation. To follow the exhibit closely one drew the conclusion that all such annoyances have been dispensed with and the mere mention of ashes, soot or dust was to offer thoughtless umbrage to the savants who have devoted their careers to relegating these words to the vocabulary limbo of our craft.

There was a modicum of comfort to the man who is his own fireman. To such a man, a coal furnace that turns on and off with a twist of the wrist, or the oil burner or the gas burner, is a step into the ultimate. There they were, fascinating to contemplate, glowing with pale emerald and sapphire flame, sending little B.tu's cavorting through the pipes, and with no more effort than the flashing of an electric spark.

There were the humidifiers and the dehumidifiers. There were blowers that blow "cold" when the weather is hot, and blowers that blow "hot" when the weather is cold.

The officers and many members of the SOCIETY as well as manufacturers had long desired a show at which only heating and ventilating equipment would be exhibited, and it was believed that a purely heating and ventilating exposition would appeal not only to the SOCIETY but to the industry and the public. The Council received repeated requests to endorse previous heating and ventilating shows, but after investigation declined to sponsor them.

About two years ago a special committee was appointed by the Council to meet with representatives of the International Exposition Company, managers of the New York Power Show, to investigate the possibilities of a heating and ventilating exposition. As the Power Show had been an outgrowth of the Chemical Show, and had been an unqualified success, there was no hesitancy in having the International Heating and Ventilating Exposition under the same management.

An Advisory Committee was appointed by Pres. Thornton Lewis early in 1929, to work with C. F. Roth, the show manager. This committee consisted of H. P. Gant, Philadelphia, *Chairman;* E. B. Langenberg, St. Louis; J. I. Lyle, Newark, N. J.; J. F. McIntire, Detroit; F. R. Still, New York City; H. L. Whitelaw, New York City; E. K. Webster, Camden, N. J.; H. C. Murphy, Louisville, Ky.; A. S. Armagnac, New York City; D. S. Boyden, Boston; and A. C. Edgar, Philadelphia; W. H. Carrier, Newark; Roswell Farnham, Buffalo, N. Y., and C. V. Haynes, New York.

In addition, a cooperative committee representing national allied organizations, was appointed to work with the Advisory

Committee. This committee consisted of O. H. Fogg, President, *American Gas Association;* C. H. Hammond, President, *American Institute of Architects;* E. M. Fleischmann, President, *American Oil Burner Association;* A. J. Wood, President, *American Society of Refrigerating Engineers;* Walter Klie, President, *Heating and Piping Contractors National Association;* H. T. Richardson, President, *National Boiler and Radiator Manufacturing Association;* John W. Meyer, President, *National District Heating Association;* W. C. Hanson, President, *National Pipe and Supplies Association;* C. E. Hall, Director, *National Warm Air Heating Association;* R. T. Creviston, Manager, *Plumbing and Heating Industries Bureau.*

The Exposition was sponsored by the SOCIETY, and the Research Laboratory receives a percentage of all the fees paid for space. The original agreement provided for a specified allowance to the SOCIETY, but the management voluntarily doubled this amount. The SOCIETY undertook no liability, and assumed no responsibility for the financial success of the Exposition.

The SOCIETY sponsored exhibits in eleven booths at the Exposition, two for the headquarters office, and nine for the Research Laboratory and institutions cooperating therewith. The two booths provided for the headquarters office were primarily for the purpose of disseminating information regarding the Exposition, the SOCIETY, the various activities in connection with the Annual Meeting, details concerning transportation and the City of Philadelphia. The booth was in charge of a representative of the headquarters office. Copies of the various papers presented at the meeting were made available at this booth, as well as other documents relating to the SOCIETY and the Exposition. An enlarged reproduction of THE GUIDE, 1930, attracted considerable attention.

The exhibit of the Research Laboratory consisted of a demonstration of the application of the Nicholls' Heat Flow Meter to three problems. The first set-up was intended to demonstrate the sensitivity of the instrument by allowing visitors to cause a deflection of a galvanometer beam by placing their hands near the meter. The second was devised to show the effect of still and moving air on heat loss from a given surface. The third demonstrated the apparatus used to determine the absorption of solar radiation. Numerous charts and photographs depicted the progress of the Laboratory in the last few years.

Cooperating institutions were represented. The University of Minnesota apparatus was for testing the conductivity of building materials and insulations by the hot plate method. Armour Institute of Technology demonstrated the method of measuring the flow of air through registers and grilles. Texas A. and M. College showed, by means of glass models, the operation of two hot water heating systems, one designed for the water to flow continuously in the right direction, and the other designed for reversed flow of water in the last two radiators. The various projects being investigated under cooperative agreements at Carnegie Institute of Technology, Harvard University School of Public Health, University of Wisconsin and Yale University, were described by charts and pictures.

The U. S. Bureau of Mines Experiment Station exhibited the continuous carbon monoxide recorder. This is being used at present in the Holland Tunnel in New York, and by a number of research laboratories. The Hoolamite carbon monoxide indicator, the self-rescuer, the Bureau of Mines approved all-service gas mask and the pyrotannic acid method for determining the concentration of carbon monoxide in blood and air were also shown.

The U. S. Bureau of Standards display included samples of various types of insulation such as corrugated cardboard, cork board and materials manufactured from layers of newspaper, shredded newspaper, felt, jute, jute felt, hair felt, curled hair, sea weeds, wood pulp, flax and straw, rock wool and vegetable fiber, licorice fibers, sugar cane fibers, slag wool and binder, cellular gypsum, corn stalks, asbestos, wood chips and binder, rock wool and vegetable fiber with bituminous binder, curled glass wool, straight glass wool, sisal, moss, feathers, wood shavings with binder, compressed straw and balsa wood.

The *American Gas Association* occupied four attractive booths adjoining exhibits of manufacturers of gas heating equipment. The growing use of gas for house heating was depicted graphically by means of charts.

The *American Oil Burner Association* had an appropriate assembly of enlightening information in their booth. This display brought to the New York headquarters of the association approximately one hundred requests for further information.

The *Anthracite Coal Service* display featured motion pictures describing the proper manner of burning anthracite coal, pointing out the common mistakes made by homeowners in firing the heating plant. Models of various types of equipment designed for burning the various sizes of anthracite were shown. One of the very interesting features of equipment shown was a device which is a thermostat operating on room temperature. The novel feature of this thermostat is the absence of electrical connection, springs or weights.

The *National Association of Power Engineers* was represented and educational and other features of the organization were fully explained to hundreds of visitors. The *N. A. P. E.* is a progressive organization consisting of over 20,000 power engineers throughout the United States. It has a well-defined program of progress which will culminate in a glorious finish of fifty years of association activity in 1932.

The Board of Education of Philadelphia displayed plans and photographs of three typical school buildings, namely, senior high, residential and elementary. Photographs illustrating heating, ventilating and power equipment were shown.

The historical exhibits outlined the history of heating from the day of the cave dweller to the present time. The developments up to the time of wood burning stoves were depicted by water color pictures.

Probably the most interesting piece in the entire exposition was the cannon-type stove of 1739, attributed to Baron Stiegel, the famous Revolutionary iron founder who made cannon for General Washington's army. The Baron's stove, with a tulip design decoration and claw feet, both believed to be copied from the furniture of the period, was purchased in London in 1880, in a junk shop.

From the Pennsylvania Museum, of which the new Art Museum in Philadelphia is a part, was obtained a collection of wood burning stoves about a century old. Several of them were the invention of Dr. Eliphalet Nott, President of Union College. One of them, with a high narrow back, reminded the spectators of a grandfather's clock. Several stoves of Pennsylvania-Dutch origin and other curiosities were included in the historical exhibit.

An 1859 Gold boiler, made from the patents of Samuel Gold, and also a Gold pin radiator, were contributed. It was interesting to note that one of the most modern radiators, one just recently produced and exhibited by another company, was designed on the same principle as the original Gold pin radiator.

Another very interesting contribution was the first cupola blower made about 1870 and in service more than 50 years. A series of nine valves illustrating the history and development of the radiator trap were displayed.

A warm air furnace which had been installed in a farm house at Fredonia, Mich., in 1894, and which was in service until some time last year, was shown. A similar contribution was a boiler which was removed from a home on Long Island, in exchange for a new boiler so that the old apparatus might be exhibited. This was in service 40 years and had continued to give satisfaction up to January 16th of this year.

The exhibitors were arranged in eight groups covering Combustion, Hydraulics, Air, Control, Refrigerating, Central Heating, Insulating and the Miscellaneous Groups. The Combustion Group included manufacturers of furnaces, burners (oil and gas), grates, stokers, boilers, radiators, refractories and auxil-

iaries. The Hydraulic Group included the manufacturers of water heaters, pumps, traps, valves, piping, fittings, expansion joints, pipe hangers. The Air Group included the manufacturers of warm air furnaces and stoves, registers and grilles, cooling towers, air filters, motors, fans, blowers, conditioning equipment, ventilators and unit heaters. The Control Group consisted of manufacturers of instruments of precision for indicating, controlling or recording temperature, pressure, volume, time, flow, draft or any other function to be measured. In the Refrigerating Group were displayed the products of manufacturers of compressors, condensers, cooling apparatus, contingent apparatus and refrigerants for homes, factories and railroads. The Central or District Heating Group consisted mainly of apparatus and materials especially designed or adapted to the uses of central heating and central heating station supplies. The Insulating Group included rigid and flexible insulations and fills, asbestos, magnesia clays, pipe and conduit covering, weatherstripping, etc. In the Miscellaneous Group were included manufacturers of electric heaters, boiler and pipe repair alloys, liquids and compounds and others which were not included in the other seven groups.

The observer was attracted by a combination water and fire tube boiler with an unusually low water line which was on display in the combustion group. In this boiler the usual screwed hand hole plugs are replaced with standard water tube boiler hand hole caps.

An exhibit in which many visitors were interested was that of a manufacturer of a complete line of steel fire box riveted and welded boilers, with a range of capacities from that required for the home to the skyscraper. An all-steel riveted return flue fire box boiler was displayed, as well as two electric welded portable return flue steel fire-box boilers, one of the residence type, and one of the larger type with corrugated crown sheet. The booth was fenced off by sections of slim-type nipple radiators, each mounted with a small boiler model.

It was apparent that many boiler manufacturers are endeavoring to develop an aesthetic appeal. Attention was attracted to a jacketed steel residence boiler finished in gray enamel with black enamel trim. These colors were selected by women at a previous exhibit, ninety-two per cent of whom chose this finish.

Two boilers of copper tube construction, having quick absorption, high heat transmission, and low heat loss, and which were equipped with complete automatic and safety controls were designed to be used either for gas or oil with a high efficiency. The shell of another gas or oil fired water tube type was made of copper-bearing steel, electrically welded, the water tubes being made of copper and inclined and expanded into headers at right angles to the tubes. These tubes are accessible on the water side through a tube covered plate at the front and rear ends. Cleanout doors on each side of the boiler permit cleaning of the tubes on the fire side. Gas passages are formed by two sets of horizontal baffles making the gases travel three times the length of the boiler.

The observer was impressed by a display of six boilers in round and square jackets, with baked enamel finish and porcelain enamel doors and mineral wool insulation between the jackets and boilers. Other products on display by this concern included cast iron radiators, unit heaters and various steam and water specialties.

A new boiler for burning coke and anthracite, a radiator designed to be recessed beneath a window for which no loss of heating effectiveness is claimed, a new hand-workable acid-resisting pipe, indirect heating surface for blower systems, and a hot water heater of non-corrosive metal and various accessories, contributed to one's knowledge.

A cast iron sectional boiler, a steel fire tube boiler, and an automatic electric boiler feed and condensation unit were featured in another display, the cast iron boiler being encased in a gray jacket finished in black, and equipped with the latest automatic control and safety devices. The steel tubular boiler was equipped with all the necessary automatic control and safety devices.

Pleasing in appearance was a new jacketed boiler for both steam and water, for which a high efficiency is claimed due to the long flue and the design of the boiler sections. Visitors were attracted by a steel boiler for domestic service, designed on power boiler principles for supplying heat, furnishing domestic hot water service without the aid of a storage tank, and functioning as a garbage incinerater. A gas-fired steam boiler arranged for automatic control of steam pressure, gas pressure, secondary air, and safety pilots, was on view, as well as boilers for vapor and hot water heating systems, domestic hot water and industrial work using low pressure steam.

A complete line of cast iron coal boilers, gas boilers, cast iron radiators, floor line radiators and sanitary enamelware, was featured by one concern. Round and rectangular cast iron boilers, and a sectional type gas-fired boiler, equipped with automatic devices, occupied an extensive space. A display of interest to many spectators was a "curling flame" boiler designed especially for use with oil burners.

One was impressed with the large number of oil burners on display. It was reported that three approvals were given by the Philadelphia Fire Marshal as a result of demonstrations of oil burner firms. A feature of an exhibit of a complete line of burners for domestic and industrial installations of semi- and full-automatic types, was a cutaway model of a full automatic, rotary burner. Another attraction was a full automatic burner mounted under a 30 hp. steel boiler with fire brick lining, and all the necessary controls.

The effective use of a center exhibit showed in detail the complete internal operation of the burner on display. This exhibit took the form of three separate burner units, which through the use of glass side-walls and cutaway cross sections, clearly showed to the non-technical visitor the method of pumping and atomizing fuel oil for combustion.

A continuous flame, domestic oil burner with unusual thermostatic control equipment was commented upon by visitors. This burner has flame adjustment to five sizes to meet heating requirements.

Skillful design was the keynote of a rotary automatic oil burner using 28-30 Baumé oil. Visitors were told that a pressure atomizing type of burner on display is installed to fit the heating plant. A burner operating on an atomizing cup principle, and having a capacity of 800 sq. ft. of steam radiation, was shown. In the same booth was a model for atomizing lubricating oil to demonstrate the ability of this product to atomize high viscosity oils.

An exhibit of interest to a considerable number was the atomization of water to demonstrate how an oil burner, which is particularly adapted to warm air furnaces, prepares the fuel for combustion. A large concern displayed a typical hot water heating plant to which was attached one of their units burning 28 deg. Baumé fuel oil, and this exhibit featured the first appearance of their new small model burner having a combustion rate as low as 5/8 of a gallon per hour.

A western engineering organization exercised dexterity in the presentation of a complete line of high pressure atomizing fuel oil burners. The exhibit was centered around a revolving table upon which four burners were placed. The attention of the visitors was attracted to an oil burner designed especially for greenhouse heating, with special gasoline auxiliary equipment. Another display included a domestic type operating on a principle which, it was claimed, is the reversal of the principle known as vaporization. It was stated that this device is adapted to coal burning equipment, and is quiet in operation.

Considerable auxiliary equipment for oil burners was shown, including a line of automatic booster oil pumps used in conjunction with oil burners supplying the fuel from the storage tank to the burner automatically. A new safety feeder for oil burners, as well as two types of rotary valve duplex feeders were also shown.

The gas industry was well represented. The Philadelphia Gas

Works booth included a framed translucent picture of a carbureted water-gas apparatus, the process of the gas manufacture being brought out by the movement of colored slides. Large crowds were attracted by this exhibit. A conversion type burner attracted some attention, and an efficiency equal to that of a specially designed gas-fired unit was claimed for this unit. Both vented and unvented direct gas-fired steam radiators were on display by one of the exhibitors.

A panel depicted the products obtained from coal by carbonization in the modern by-product oven, and also illustrated the economic loss in the burning of so-called raw coal.

Several organizations interested in copper and brass heating units were represented, including a large mining concern. This organization featured a non-rusting alloy having the strength of steel, used extensively for ventilator ducts, louvers, floordrains, heating surface, etc. Considerable non-ferrous and extended surface radiation was in evidence. One manufacturer featured a typical "in-the-wall" installation of a non-ferrous radiator with an enclosure having a removable wood panel front. Manufacturers of radiator shields and enclosures were also on hand.

Proprietary heating systems were of especial interest. Notable among exhibits of this type was a miniature heating system which was in operation to illustrate the regulation of sub-atmospheric steam in mild winter weather.

The many unique heating specialties presented included a valve which controls the flow of steam based on the room temperature. This concern also featured temperature regulators for hot water generators, and steam and hot water boilers. Another manufacturer of specialties displayed radiator traps and packless supply valves for vapor and vacuum systems, combination floats and thermostatic traps for unit heaters, and main drips for low and high pressure service.

Various sizes of steam traps, together with a standard mechanism in a glass body in actual operation under 5 lb. steam pressure were included in the attraction.

An ingenious method of controlling various zones of a heating system from a central point was depicted, so that the heat emission of the heating elements can be adjusted to the requirements of each zone as affected by atmospheric conditions. A differential pressure relief valve of one of the exhibitors received an unusual amount of attention. This exhibitor was very enthusiastic about the results of the show, and volunteered the statement that it was the best exposition of any kind he had ever attended.

Five vacuum pumps of sizes ranging from 5,000 sq. ft. to 100,000 sq. ft. were presented by a Chicago concern. A Milwaukee engineering organization showed various types of unit heater traps, low pressure return traps, combination float vents and electric driven condensation pumps and receivers. An eastern organization manufacturing copper and nickel floats was represented with an appropriate exhibit. A typical boiler feed system for temperatures in excess of 300 F. was shown in the booth of another exhibitor. Many visitors were interested in a self-contained deaerator and hot water generator especially adapted for use in office buildings, hospitals, laundries and institutions.

Manufacturers of domestic hot water heating equipment were represented. One organization displayed automatic gas-fired water heaters of various types and capacities. Another featured a complete line of domestic hot water heaters for small homes, as well as large dwellings, apartments and hotels. Still another showed a new type of automatic water heater, as well as a new type of radiation, which, when assembled, gives a furniture-like appearance. A manufacturer of malleable iron, cast iron and brass fittings was represented.

Many visitors were impressed with the showing of a line of steel warm air furnaces for residential heating. A manufacturer of steel warm air heating equipment featured a furnace of fume and gas-tight construction. This heater is adapted to all types of fuel and has about 25 ft. of travel between fire box and flue. A direct gas fired warm air unit, made in sizes from 50,000 B.tu to 400,000 B.tu per hour, and using forced circulation, was exhibited by another organization.

Fans, blowers and power and motor equipment were much in evidence. These included an overlapping blade which it was claimed moves 25 to 30 per cent more air than other fans of a similar nature. A 6 ft. disc fan appealed to many visitors, as well as a centrifugal blower of a conventional design. A 27 in. fan was set up in the booth complete with a test duct, static and velocity pressure indicating instruments, and a tortion dynamometer for determining the horse power consumption of the fan.

The exhibits of manufacturers of motors were enlightening. One concern featured a squirrel-cage induction ball-bearing variable-torque two-winding motor designed for ventilating and air-conditioning apparatus. Another electrical equipment display included a complete line of fractional horsepower multi-speed condenser motors, with cutaway models showing the internal construction of the single phase and repulsion types. Motors for almost every use in the industry were presented, including those for operating louvers and shutters, automatic oil pumps, controls, gages and anti-siphon valves for oil burners.

The unit heaters and coolers, and the dehumidifiers and humidifiers were present in full force. One organization featured a machine for delivering a large quantity of tempered air in contrast to a smaller volume of hotter air. Another manufacturer showed three standard units, while still another organization exhibited unit heaters with all steel and with copper radiation, assembled with external and internal motor mounting.

A light-weight type of unit heater mounted overhead was exhibited by an eastern concern, and this organization illustrated the method by which the heated air, due to the tendency of the warmer or less dense air to rise to the ceiling, is blown downward by means of unit heaters, thus changing the temperature differential between floor and ceiling. A direct gas-fired heater with forced air circulation thermostatic control was on display.

One of the sights was a heat emission unit installed within the wall in conjunction with a fan for obtaining positive air circulation. This unit is also furnished with an electric heating element for heat diffusion by convection rather than by radiation. Unit heating and ventilating machines for schools, offices, churches, theatres, libraries and other buildings of assembly, struck a responsive chord. These units were decorated in white and gold with glass panels through which could be seen the construction and method of controlling the air, the temperature, etc.

Manufacturers of air conditioning apparatus contributed very materially to the success of the Exposition by elaborate and instructive displays. A refrigerating machine, the compressor of which is of a rotary type of simple construction, without valves, and operating at low, positive pressures, attracted considerable attention. This refrigerating machine is a part of the standard equipment used in air conditioning installations by this organization for industrial plants, theatres, etc. A popular gas-fired air conditioning unit intended primarily for residences caught the eye of many spectators. This class of equipment was also represented by a concern specializing in a gas-fired unit having a capacity of 90,000 B.tu per hour which, it was stated, is also adapted to low temperature industrial drying.

Humidifiers for homes, offices, apartments and other types of buildings were to be seen. One of these uses water at city pressure as its motive power, and draws the air into the top grille or opening and into two copper tubes returning it to the room to a lower grille, thus thoroughly saturating the air with moisture. A manufacturer of humidifiers for the home and office, specializing in portable radiator and basement types of humidifiers ranging in capacity from 2 to 15 lb. of water per hour, exhibited a portable type operated by plugging into the nearest electrical connection after filling a receptacle with water. Several air filters elicited comment, one of which provides an actual filtering surface of 45 sq. ft. in an area of less than 3 sq. ft. One of the impingement type, another using a dry process filtering medium made up of multiple layers of porous cellulose, and another also

using a dry filter, but of a different design intended for industrial use, all drew attention.

Not the least important of the exhibits was that of a concern which displayed a line of wind-driven turbines with guaranteed exhaust capacities with wind velocities of four miles per hour or greater. Another organization had on display a variety of roof ventilators of the rectangular and round types. A wind-electric full-automatic ventilator, the representatives stated, answers the question as to what happens to a roof ventilator when there is no wind.

Among the interesting sights was a double Wheatstone Bridge circuit humidity recorder. This instrument prints the relative humidity on a chart, and is guaranteed to be accurate to within ½ of 1 per cent of its range. Another exhibit in this group included automatic temperature controls for all types of heating plants. The outstanding features of this equipment are the maintenance of comfortable temperatures during the day, and an economically lower temperature at night obtained by means of a dual thermostat and a motor-wound clock.

For those interested in temperature and recording instruments, there was plenty to be seen—thermometers, flow meters, $CO_2$ meters, pyrometers for high temperatures, recording gages for pressures and low temperatures, and distant dial gages for pressures and liquid levels. Float valves, excess pressure boiler feed pump governor, constant pressure pump governors, water reducing valves, air reducing valves, balanced relief valves, altitude valves, vacuum stabilizers and suction strainers, were also shown.

A recording humidity and a relative humidity controller aroused considerable amazement, as did the temperature controllers recording thermometers, low and high pressure indicating gages, and recording gages.

Tank gages particularly adapted for use on fuel oil storage tanks were to be seen; also a line of shunt meters for measuring the flow of steam, air or gas, and a complete line of draft regulators varying in size from 4 in. to 20 in.

A method of heat regulation excited curiosity. This exhibit showed a method of temperature control by fractional filling of the radiators. The display of this organization also demonstrated the manner in which the system is completely filled with steam in cold weather and only partially filled in mild weather.

One's conception of the developments in the heating art was enlarged by a full line of automatic controls for use on oil burners, for unit heaters, stokers, coal blowers, etc. Relay switches were featured, one display consisting of three panels, the center panel showing the standard line consisting of 28 sample relays demonstrating three types of magnetic construction and five types of contact construction.

One of the novelties of the show was an exhibit which included a smoke detector operated by a photoelectric tube. A beam of light was thrown on the photoelectric tube through a glass cylinder, and when smoke was admitted to the cylinder, the intensity of the light on the sensitive photoelectric cell was decreased, thus decreasing the flow of current in the tube. This change in current offered a means of controlling a motor driven exhaust fan through the use of a suitable system of amplifiers and relays. The exhaust fan blew the smoke-laden air out of the cylinder and as soon as the air in the tube was clear, the increased light intensity on the photoelectric tube caused the exhaust fan to stop.

The central heating group was distinguished by quality rather than by the number of exhibits. One organization in particular presented a line of specialties used in this branch of the art, including special packless and slip-tight expansion joints, condensation meters, alignment guides, radiator accessories, and sectional conduit. Another organization exhibited a conduit system for insulating and protecting underground steam lines. Samples of vitrified tile were shown and also cast iron conduit used under railroad tracks at points subjected to heavy pressure.

All types of insulation for buildings, including fills, boards and flexible were represented in the insulating group. Moving pictures of the manufacturing process of one concern were of interest to a number of visitors. In another booth, all three common types of insulation were shown. A third exhibit specialized in a material which is placed in the wall by means of a blower. In addition to the building insulations, materials for furnaces and boilers were also shown, as well as materials for retarding the passage of sound from machinery through a building.

The visitor was attracted by a display of multiple punch presses and a complete line of forged steel vises. Hand torches for cutting and welding, and also a combination welding and cutting unit, particularly adapted to heating requirements, were featured.

A 3 hp. motor was arranged to drive a generator through a special type of drive, the voltage of the generator being indicated on a meter to show the uniform pull of the belt. Another attraction was a chain drive in operation under a stroboscope, which was obtained by synchronizing, approximately, the link travel of the chain with the frequency of a Neon light. The device produced the effect of a slowly moving chain and permitted the close study, through a magnifying glass, of the rocker joint action as the chain moved about the sprockets. The smooth running, positive, highly efficient and quiet operating characteristics of the chain were obvious.

An organization identified with practically all phases of heating, ventilating and air conditioning, made a complete display of industrial oil burners of the steam and air atomizing type, extended surface radiators for all types of heating and cooling, check, non-return and stop valves, rotary pumps, desuperheaters for reducing steam temperatures, and thermo-compressors for boosting steam pressures from low exhaust pressures to working steam pressures.

A total of 57,500 visitors attended the Exposition, many of whom came from foreign countries including Germany, England, Japan, Australia, Russia, Switzerland, Sweden and Canada. Of course, it was not possible accurately to tabulate all of the inquiries received, but the experience of one manufacturer is indicative of the value of the exposition. This manufacturer received 125 tangible inquiries which he believes will develop business. Of these inquiries, 26 were from the City of Philadelphia, 23 from the State of Pennsylvania, 14 from New York State, 8 from New Jersey, 4 from Maryland, 3 from Missouri, 3 from Minnesota and the remaining from various other parts of the United States and foreign countries.

According to present plans, a Heating and Ventilating Exposition will be held every two years in some large city during the week of the Annual Meeting of the Society. If the manufacturers of the industry adopt the policy of participating in the Exposition every two years, the cost of exhibiting their equipment will be nominal. A distinct advantage should result from holding the Exposition in different parts of the country rather than always in any one particular city.

## Albert Buenger Heads St. Paul Engineers

Albert Buenger, who is the general chairman on arrangements for the Semi-Annual Meeting of the Society, June 24 to 27, 1930, has recently been elected President of the Engineers Society of St. Paul, Minn., for the year 1930.

This Society, located at 1021 Guardian Life Bldg., was organized in 1883.

Mr. Buenger has served as president, secretary and treasurer of the Minnesota Chapter of the American Society of Heating and Ventilating Engineers, and has a wide circle of friends in the Society through his attendance at numerous national meetings.

## Offices for Newport Boiler Co.

L. Halliday, vice-president of Newport Boiler Co., Chicago, advises that the general offices of the company are to be located in the new Chicago Daily News Bldg., 400 West Madison St.

# Local Chapter Reports

## Illinois

*February* 10, 1930. The Illinois Chapter of the SOCIETY held a very successful meeting at the Hotel Sherman, Chicago, on February 10, with an attendance of 109 members and guests.

The speaker of the evening was Homer R. Linn, who gave a very informative and interesting talk on the status of oil burners in the industry today. The statistics Mr. Linn gave showed remarkable growth and apparent stability and permanence of the industry. He reviewed some of the difficulties and the contributing causes, and also made some excellent recommendations to assist one in making a choice of oil burners.

Harry F. Tapp, secretary of the *American Oil Burner Association* and Byron Eaton, president of the *Chicago Oil Burner Association* were then introduced.

Pres. H. G. Thomas announced the death of two members of the Illinois Chapter, Mr. Allan and Mr. McLelland. Following a moment of silent meditation Mr. Linn, Mr. Kreissl, Mr. Johnson and Mr. Hart, respectively, were appointed to appropriately express the sympathy of the members to the families of the deceased.

After the minutes of the January meeting were read and approved, John Howatt discussed the action at the Annual Meeting regarding the Report of the Codes for Testing and Rating Steam Heating Solid Fuel Boilers, and it was decided to discuss this matter more fully at the March Chapter meeting.

A rising vote of thanks was extended to Mr. Linn, which was followed by adjournment.

## Massachusetts

*January* 13, 1930. Thirty-five members and guests attended the monthly meeting of the Massachusetts Chapter of the SOCIETY held at the Boston City Club.

W. H. Oleson, secretary of the *Heating and Piping Contractors National Association* in Boston gave an interesting talk on the subject of Certified Heating.

R. S. Franklin then explained in detail the method of arriving at the standards upon which the calculations for a certified heating job are made, which was followed by a discussion in which the various members took part.

J. F. Tuttle was elected as the Massachusetts member of the SOCIETY to serve on the Nominating Committee with T. F. McCoy as alternate.

*December* 9, 1929. The December meeting of the Massachusetts Chapter of the SOCIETY held its regular meeting at the Boston City Club, with an attendance of about 45 members and guests.

After luncheon, which preceded the meeting, Webster Tallmadge, New York, delivered an instructive discussion on Recent Development in the Control of Direct Steam Heating, which apparently was thoroughly enjoyed by those present.

An interesting discussion followed Mr. Tallmadge's talk which was followed by adjournment.

## Michigan

*December* 16, 1929. The December meeting was held at the Cadillac Athletic Club, Detroit, Mich., with an attendance of 73 members and guests.

After a few remarks by George Clifford, the district manager of the A. M. Byers Co., Chapter President William Boales introduced the speaker of the evening, Dr. James Aston, Dean of the School of Mining and Metallurgy at Carnegie School of Technology. Dr. Aston is also Consulting Metallurgist for the A. M. Byers Co. His talk, which was illustrated with motion pictures, covered in a very simple and thorough manner the manufacture of wrought iron pipe.

After Dr. Aston's address, a general discussion was participated in by several of the chapter members.

## New York

*February* 17, 1930. This meeting was distinguished by the presence of two notable speakers, namely, Willis H. Carrier, Vice-President of the SOCIETY, and F. W. Hanburger, Special Lecturer on Heating and Ventilation, of the College of the City of New York, whose subject was, Heating Design as Taught and Practiced.

Mr. Carrier discussed the Boiler Rating Code, which is to be voted on by members of the SOCIETY in accordance with a resolution adopted at the Annual Meeting. The discussion included an explanation of the original code as adopted in January, 1929, as well as the proposed revisions. C. W. Obert and Raymond Newcomb presented their views on the matter, and strongly urged that the SOCIETY give consideration to the one-number or dimensional methods of rating. These gentlemen expressed the opinion that the members of the *Steel Heating Boiler Institute* were not wholly satisfied with this code. Mr. Carrier replied that the recommended revisions represented the nearest approach that had thus far been attained with respect to bringing together the differences of opinion involved.

Mr. Hanburger related some of his experiences in connection with his duties as lecturer at C. C. N. Y. on heating and ventilation, and called attention to the fact that the conditions existing in practice do not always agree with the theoretical considerations on which the calculations are based. Mr. Hanburger also told of some of his experiences relating to projects on which he had been retained as the consulting engineer. His views were very interesting.

## Philadelphia

*December* 12, 1929. The Chapter was very glad indeed to have both the National President, Thornton Lewis, and the National Secretary, A. V. Hutchinson, present for this occasion.

A brief business meeting was held and R. E. Jones, Chairman of the Nominating Committee, presented the following names as candidates for Chapter Officers and Board of Governors for 1930: *President,* Harry Black; *Vice-President,* E. N. Sanbern; *Secretary,* L. C. Davidson; *Treasurer,* Walter Wild; *Board of Governors,* A. C. Edgar, A. J. Nesbitt, M. P. Blankin.

As this was Ladies' Night, the program included a card party and dance.

## St. Louis

*February* 5, 1930. F. J. McMorran, the principal speaker of the evening, discussed the application of unit heaters of various types to the heating problems of buildings.

After a brief outline, Mr. McMorran called on George Myers who read a paper on the application of the floor type unit heater. Mr. McMorran then called on C. W. Butler who read a paper on the application of the suspended type units. Both papers treated the subject at hand very completely and aroused considerable discussion in which all members present took a part.

J. M. Foster, chairman of the Program Committee, reported that the program had been completed up to vacation time as follows: The March meeting is to be devoted to Gas Heating, the April meeting to Warm Air Heating, the May meeting to Ventilation, and the June meeting is to be given over to Ladies' night.

J. E. Manahan reported for the Entertainment Committee, and stated that the St. Louis Chapter will sponsor a dinner dance to be given in the Green Room of the Coronado Hotel on February 20, 1930.

President White called on the members present who had attended the Annual Meeting of the Society at Philadelphia to give a brief outline of their trip. A resolution was adopted expressing the sympathy of the Chapter to Tom Hester for the loss of his father, who passed away recently.

There were 30 members and 15 guests present.

## Western New York

*January* 20, 1930. The monthly meeeting of the Western New York Chapter was held at the University Club, Buffalo, on Monday evening, January 20, 1930.

A short business meeting was held during which O. K. Dyer was elected as delegate and D. J. Mahoney as alternate for the Western New York Chapter to attend the Semi-Annual Meeting to be held in Minneapolis, June 24 to 27, 1930.

The balance of the evening was devoted to a social which proved very interesting, with a buffet supper served at 10 o'clock.

*December* 19, 1929. The December meeting of the Western New York Chapter of the American Society of Heating and Ventilating Engineers took the form of a joint meeting with the *American Society of Mechanical Engineers* and was held at Rochester, N. Y., on the afternoon and evening of December 19.

In the afternoon a group of members and guests met at the Lithographic Co., where they were welcomed by the superintendent, G. C. VanVecten, who divided the group into three parties and an inspection of the plant followed immediately. The inspections were lead by very capable employes of the company, who explained every process of manufacture.

Following the inspection trips the meeting reconvened at the Sagamore Hotel where the members and guests assembled for dinner. At the approach of the business meeting there were 90 in attendance. Mr. VanVecten, president of the Rochester chapter of the *A. S. M. E.*, acted as chairman of the meeting, and introduced O. K. Dyer, president of the Western New York Chapter of the Society, who complimented the members for the attendance at the meeting, and also expressed the appreciation of the Society for the co-operation given in arranging the Rochester meeting.

President Dyer called on R. T. Coe as a member of the Nominating Committee, who presented the following names of the officers for 1930:

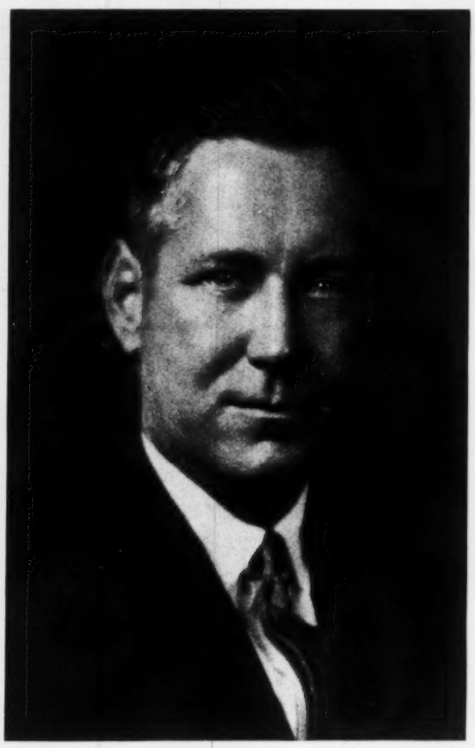
*President,* Fletcher Burke.
*First Vice-President,* Joseph Davis.
*Second Vice-President,* Myron Beman.
*Secretary,* D. J. Mahoney.
*Treasurer,* C. H. Love.

Mr. VanVecten then introduced the speaker of the evening, Mr. Fairfax, engineer for the Stecher Lithographic Co., who presented a paper covering the story of central steam and power generation for the factory district surrounding the Stecher plant. This was followed by a moving picture showing the effect of patented solutions used in purifying boiler water, presented by the American Illuminating Co., which was explained by the Rochester representative, Mr. Long.

## New Research Secretary Appointed

During the Annual Meeting of the Society in Philadelphia the Council announced the appointment of Thomas J. Duffield as Executive Secretary for the Committee on Research, effective February 1, 1930.

Because of the pressure of work resulting from a growing research program the Committee on Research found that there was urgent need for a qualified man to assume the administrative duties formerly handled by the chairman of the Committee. The



Thomas J. Duffield, Executive Secretary of the Committee on Research

appointment of Mr. Duffield followed the recommendation of the Committee on Research, and he will be found at the new headquarters office of the Society, 51 Madison Av., New York.

Mr. Duffield is known to a great many of the Society members through his contribution of papers on subjects relating to ventilation and health, and his many friends in the organization will be glad to know that he has taken this post in connection with the Society's Research program.

He brings to this new Society activity a wealth of experience in the field of public health and a keen interest in the subject of ventilation, through his former work as executive secretary of the New York Commission on Ventilation, his research work for the Milbank Memorial Fund, his service as field epidemiologist for the League of Nations in Europe, as statistician for the Rockefeller Tuberculosis Commission in Paris, and as an instructor at the School of Public Health, Harvard University.

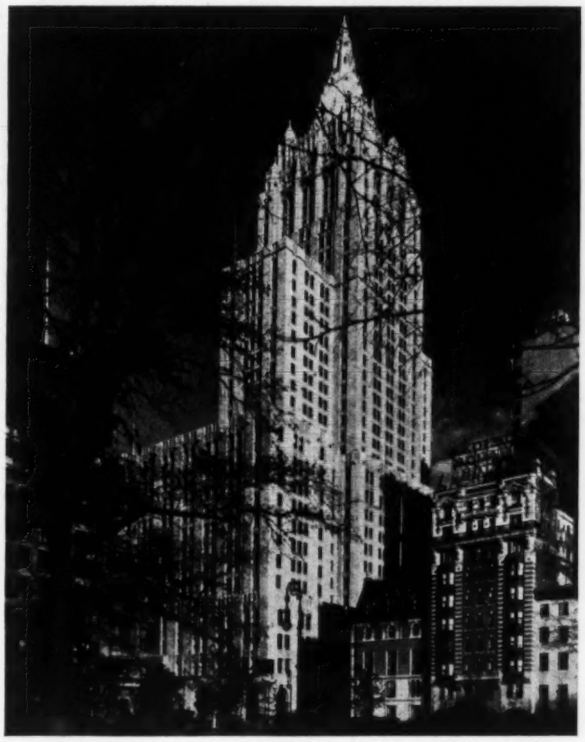
After his graduation from Massachusetts Institute of Technology with a B. S. Degree, Mr. Duffield served as health officer for the city of Summit, New Jersey, and during the war was Major in the Sanitary Corps of the U. S. Army, attached to the office of the Chief Surgeon of the A. E. F.

## New Society Headquarters in New York Life Building

By March 20, the A. S. H. V. E. will be housed in its new headquarters on the 31st floor of the New York Life Insurance

Bldg., 51 Madison Avenue, New York, where more commodious quarters have been selected by the Council in order adequately to care for the increasing Society activities.

This location at 27th Street is quite convenient to the two railroad terminals, Pennsylvania and Grand Central, as well as to the leading hotels, by direct subway connection. In this monumental building, on the site of old Madison Square Garden, the outlook is unobstructed by surrounding buildings so that ideal working conditions are assured. The new equipment and furnishings voted by the Council provide for greater efficiency and a more attractive headquarters office.



The New York Insurance Building, in Which Will Be Located the Headquarters of the Society

The present offices in the Engineering Societies Bldg. are given up to meet the requirements of our growing Society after a tenancy of 19 years. During this time the organization has made great strides, growing from a membership of about 400 to more than 2,000, so that for many of the older members there will be pleasant recollections of our association with the founder societies and their encouragement and co-operation.

## Death of H. B. McLelland

On January 18, 1930, H. Burton McLelland died at his home, 129 N. Menard Ave., Chicago, and his many friends in the Society will learn with regret of his passing.

Mr. McLelland was born in Buffalo, N. Y., on August 10, 1864, and his entire life after leaving school was spent in the heating specialty field. For more than 25 years Mr. McLelland was continuously associated with Jenkins Bros., manufacturers of valves and heating specialties, and his death came as a shock to his business associates who mourn his loss.

Mr. McLelland was active in association and fraternal circles and had a host of friends in the many organizations with which he was identified. He had been a member of the Society since 1912 and had always taken an active part in affairs of the Illinois Chapter. He was a member of the *National Association of Power Engineers,* Illinois Athletic Club and other local and fraternal organizations.

At the February meeting of the Illinois Chapter, announcement of his passing was made and the members conveyed an expression of their sympathy to his widow and two daughters who survive.

## James Aston Honored

At the annual dinner of the *American Institute of Mining and Metallurgical Engineers,* in the Hotel Commodore, New York, on February 19, Dr. James Aston, director of mining and metallurgy at the Carnegie Institute of Technology, and consulting metallurgist of A. M. Byers Co., Pittsburgh, received the Robert W. Hunt Medal for his paper on A New Development in Wrought Iron Manufacture.

James Aston

The presentation was made by George B. Waterhouse, professor of metallurgy of Massachusetts Institute of Technology. Dr. Aston is the fifth recipient of this reward.

The fellow members of Dr. Aston in the A. S. H. & V. E. will be pleased to know of the distinction conferred upon him.

Dr. Aston was born in England in 1876. His early education was received in Milwaukee, and he graduated from the University of Wisconsin in 1898 with a B. S. degree in electrical engineering. In 1908 he returned to the University of Wisconsin to do research work and then for several years served as an instructor in metallurgy.

In 1912 he went to the University of Cincinnati and later became a member of the staff of the U. S. Bureau of Mines, Pittsburgh. In 1915 Dr. Aston became chief metallurgist of the A. M. Byers Co., and is now a consultant for this company, and head of the department of mining and metallurgical engineering at Carnegie Institute of Technology.

# CANDIDATES FOR MEMBERSHIP

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the name of applicants and their references shall be printed in the next issue of the Journal of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Membership Committee as soon as possible.

When the Membership Committee has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 59 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Membership Committee, and in turn the Council, urge the members to assume their share of the responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by March 5, 1930, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary, immediately after election.

| CANDIDATES | REFERENCES | |
|---|---|---|
| | *Proposers* | *Seconders* |
| ACKERMAN, REYNOLD H., Carrier Engrg. Corp., Newark, N. J. | W. A. Bornemann<br>P. L. Davidson | A. P. Shanklin<br>D. Williams |
| BERTHET, EDWARD E., Pittsburgh Branch Mgr., Skinner Bros. Mfg. Co., Inc., St. Louis, Mo. | E. C. Evans<br>Thomas Chester | H. L. Moore |
| BOND, HORACE A., Manager, Warren Webster Co., Albany, N. Y. | E. K. Lanning<br>C. F. Eveleth | E. K. Webster<br>R. T. Coe |
| BROWN, JAMES LESTER, Partner, Eames & Brown, Pontiac, Mich. | G. H. Giguere<br>J. L. Fuller | H. C. Kappler<br>W. A. Blessed |
| BUCHER, HARRY GEORGE, C. A. Dunham Co., Pittsburgh, Pa. | E. C. Evans<br>C. W. Wheeler | H. E. Digby<br>G. S. McEllroy |
| BURK, C. FRANKLIN, Sheldons, Ltd., Galt, Ont., Canada. | H. G. McCaffrey<br>John Evans | E. B. Sheffield<br>M. F. Thomas |
| BUTT, RODERICK E. W., Carrier Engrg. Co., Ltd., London, England. | W. G. Hillen<br>S. L. Groom | W. H. Carrier<br>J. I. Lyle |
| CHITTENDEN, EDWIN FOSTER, Branch Mgr., The Herman Nelson Corp., Moline, Ill. | G. H. Giguere<br>F. C. Purcell | E. C. Clark<br>W. A. Blessed |
| COOK, RALPH P., Htg. & Vtg. Engr., Eastman Kodak Co., Rochester, N. Y. | P. H. Schoepflin<br>A. R. Acheson | A. V. Hutchinson<br>R. T. Coe |
| CORNELL, J. CLARENCE, Draftsman, United Engineers & Constructors, Inc., Philadelphia, Pa. | L. L. Driggs<br>E. N. Sanbern | G. W. Keys<br>H. M. Patrick |
| COUCH, NORMAN HAROLD, N. Y. Edison Co., New York, N. Y. | R. W. Cumming<br>E. J. Ritchie | H. B. Hedges<br>A. J. Offner |
| DOLAN, HUGH P., Supervising Engr., Detroit Board of Education, Detroit, Mich. | G. H. Giguere<br>L. L. Smith | H. M. Stephen<br>H. C. Kappler |
| DONOVAN, WILLIAM J., 2239 North 27th St., Philadelphia, Pa. | Benjamin Adams<br>L. C. Davidson | H. G. Black<br>E. N. Sanbern |
| EAMES, W. RUSSELL, Member of Firm, Eames & Brown, Pontiac, Mich. | G. H. Giguere<br>J. L. Fuller | H. M. Stephen<br>J. E. Degan |
| FAMILETTI, A. ROBERT, Mensing & Co., Philadelphia, Pa. | E. N. Sanbern<br>H. M. Patrick | F. D. Mensing<br>A. A. Miller |
| FERGUSON, THOMAS, Warden King, Ltd., Toronto, Ont., Canada. | W. R. Blackhall<br>L. A. Hood | Edward Addy<br>J. J. MacKenzie |
| FINNEY, GERALD JOSEPH, Carrier Engrg. Corp., Newark, N. J. | W. A. Bornemann<br>P. L. Davidson | A. P. Shanklin<br>R. C. Simms |
| FOSTER, JAMES M., Ilg Electric Ventilating Co., Chicago, Ill. (*Advancement*) | E. A. White<br>L. W. Moon | R. R. Ferguson<br>G. W. F. Myers |

| | | |
|---|---|---|
| HALLETT, SAMUEL G., Mgr., The Hallett Engrg. Co., St. Louis, Mo. | Paul Sodemann<br>C. R. Davis | J. W. Cooper<br>W. T. Thomsen |
| HARRIS, JESSE E., Asst. Sales Mgr., Cochrane Corp., Philadelphia, Pa. | F. D. Mensing<br>E. N. Sanbern | H. M. Patrick<br>A. A. Miller |
| HARTMAN, GEORGE F., Fallansbee Bros. Co., Pittsburgh, Pa. | E. C. Evans<br>H. L. Moore | G. S. McEllroy<br>Thomas Chester |
| HEMPHILL, DAVID ANDREW, York Htg. & Vtg. Corp., Pittsburgh, Pa. | E. C. Evans<br>G. S. McEllroy | H. B. Orr<br>H. L. Moore |
| HERSH, FRANKLIN CHARLES, Carrier Engrg. Corp., Dallas, Tex. | W. G. Hillen<br>L. L. Lewis | M. S. Smith<br>H. Worsham |
| HOSHALL, ROBERT HOUSTON, Associate of Thos. H. Allen, Consulting Engr., Memphis, Tenn. | Paul Sodemann<br>W. H. Allen | R. R. Ferguson<br>W. T. Thomsen |
| HOSKING, HOMER L., U. S. Radiator Corp., Detroit, Mich. | G. H. Giguere<br>R. F. Connell | W. G. Boales<br>H. C. Kappler |
| INE, FRANK H., Mgr. of Htg. Div., Young Radiator Co., Racine, Wis. | H. W. Page<br>H. M. Miller | A. M. Freeman<br>A. F. Bowers |
| INGLEFIELD, CHARLES L., Treas., Bushnell Mchy. Co., Pittsburgh, Pa. | E. C. Evans<br>G. S. McEllroy | H. L. Moore<br>Thomas Chester |
| JOHNSTON, JAMES H., Branch Mgr., U. S. Radiator Corp., Harrison, N. J. | P. D. Butler<br>H. R. Birch | M. G. Hook<br>J. R. Murphy |
| KELLY, JEROME J., Vice-Pres., Wisconsin Equipment Co., Milwaukee, Wis. | H. W. Page<br>H. M. Miller | A. M. Freeman<br>A. F. Bowers |
| KRENZ, ALFRED S., Wisconsin Equipment Co., Milwaukee, Wis. | H. W. Page<br>H. M. Miller | A. M. Freeman<br>A. F. Bowers |
| KRUSE, ROBERT W., Kruse Co., Indianapolis, Ind. | J. C. Miles<br>W. G. Culbert | R. E. Jones<br>T. W. Cooper |
| LASALVIA, JAMES JOHN, Chief Mech. Engr., Chas. S. Leopold, Philadelphia, Pa. | G. H. Giguere<br>W. G. Boales | H. M. Stephen<br>W. A. Blessed |
| LOUCKS, DAVID WENDELL, Duquesne Light Co., and Allegheny Steam Htg., Co., Pittsburgh, Pa. | E. C. Evans<br>R. J. J. Tennant | G. S. McEllroy<br>H. L. Moore |
| MARKS, ALEXANDER ASHTON, Asst. Sales Mgr., Richmond Radiator Co., Philadelphia, Pa. | H. S. Minnich<br>A. H. Schroth | R. E. Jones<br>H. A. Erickson |
| MCCLANAHAN, LUTHER CLEVELAND, Sales Engr., Buffalo Forge Co., Pittsburgh, Pa. | E. C. Evans<br>H. L. Moore | G. S. McEllroy<br>H. A. Bowman |
| MCCULLOUGH, JOHN LEWIS, Sales Engr., Direct Control Valve Co., Pittsburgh, Pa. | E. C. Evans<br>F. A. Gunther | G. S. McEllroy<br>H. L. Moore |
| MCNAMARA, WILLIAM, Sales Engr., The Trane Co., Minneapolis, Minn. | F. C. Winterer<br>A. M. Wagner | A. J. Huch<br>H. J. Sperzel |
| NENTWIG, RAY J., Murray W. Sales & Co., Detroit, Mich. | G. H. Giguere<br>H. M. Stephen | H. C. Kappler<br>W. A. Blessed |
| O'DAY, CORTLAND N., Mgr., Industrial Htg. Dept., Buckeye Blower Co., Columbus, Ohio. | G. H. Giguere<br>H. M. Stephen | H. C. Kappler<br>W. A. Blessed |
| PHIPPS, FREDERICK GEORGE, C. A. Dunham Co., Montreal, P. Q., Canada. | G. L. Wiggs<br>M. W. Shears | A. J. Dickey<br>J. P. Linton |
| PITTOCK, LOUIS BURNS, 902 Oliver Bldg., Pittsburgh, Pa. | E. C. Evans<br>G. S. McEllroy | F. A. Gunther<br>H. L. Moore |
| RANK, DAVID J., Chief Engr., Grant Bldg., Pittsburgh, Pa. | E. C. Evans<br>H. L. Moore | H. A. Bowman<br>C. W. Wheeler |
| REED, VAN A., JR., Secy., Treas. & Chief Engr., Federal Engrg. Co., Pittsburgh, Pa. | E. C. Evans<br>H. L. Moore | G. S. McEllroy<br>Thomas Chester |
| REINKE, FLOYD C., American Insulating Co., Detroit, Mich. | G. H. Giguere<br>H. M. Stephen | H. C. Kappler<br>W. A. Blessed |
| ROBINSON, MAYES RANDOLPH, Sales Engr., Bushnell Mchy. Co., Pittsburgh, Pa. | E. C. Evans<br>H. L. Moore | H. A. Bowman<br>C. W. Wheeler |
| ROSE, WILLIAM KENDALL, Chief Engr. & Genl. Mgr., Chase Co., Ltd., London, England. | C. S. Hawdon (*IME*)<br>L. Call (*Non-Member*) | S. C. Fielder (*IHVE*)<br>T. E. Beeson (*IHVE*) |
| RUFF, DANIEL HAINES, JR., Acme Tin Plate & Roofing Supply Co., Philadelphia, Pa. | J. J. Wilson<br>A. McClintock | A. C. Edgar<br>H. J. Walther |
| SANTEE, HELEN COOPER, Asst. to Archt. & Engr., Wilkes-Barre School District, Wilkes-Barre, Pa. | F. D. Mensing<br>H. P. Gant | E. N. Sanbern<br>Thornton Lewis |

| | | |
|---|---|---|
| SAUER, ROBERT L., Riley Stoker Corp., Detroit, Mich. | G. H. Giguere<br>H. M. Stephen | W. J. Whelan<br>H. C. Kappler |
| SCHERNBECK, FRED H., SALESMAN, Williams Bros. Boiler & Mfg. Co., Nicollet Island, Minneapolis, Minn. | D. M. Forfar<br>H. E. Gerrish | E. F. Jones<br>Albert Buenger |
| SMITH, ROBERT CRAWFORD, Sales Repr., Columbia Radiator Co., Pittsburgh, Pa. | E. C. Evans<br>C. W. Wheeler | H. E. Digby<br>G. S. McEllroy |
| SPRAGUE, JAMES F., Pres., Sprague Engrg. Co., Milwaukee, Wis. | H. W. Page<br>H. M. Miller | A. M. Freeman<br>A. F. Bowers |
| STRACHAN, GEORGE WALTER, Chief Engr. of Design, C. A. Dunham Co., Pittsburgh, Pa. | E. C. Evans<br>H. L. Moore | H. A. Bowman<br>C. W. Wheeler |
| TEELING, GEORGE A., N. Y. State Manager, B. F. Sturtevant Co., Rochester, N. Y. | William Roebuck, Jr.<br>D. J. Mahoney | H. B. Roarke<br>R. T. Coe |
| TETEREVNIKOFF, NIKOLAS, Asst. Prof., Polytechnic Engineering School, Leningrad, Russia. | F. C. Houghten<br>Saul Saulson | G. H. Giguere<br>H. M. Stephen |
| TELLER, WILBUR W., The Ric-Wil Co., Cleveland, Ohio. | J. F. Tuttle<br>W. P. Mower | A. A. Klonower<br>R. S. Franklin |
| TOWER, ELWOOD S., Chief, Engrg. Dept., American Radiator Co., Pittsburgh, Pa. | E. C. Evans<br>G. S. McEllroy | H. L. Moore<br>Thomas Chester |
| URDAHL, THOMAS HAROLD, Consulting Engr., 1010 Vermont Ave., N. W., Washington, D. C. | F. I. Cooper<br>Herbert Coward | Dr. F. H. Newall<br>(*Non-Member*)<br>G. C. Breitenbach |
| VETLESEN, G. UNGAR, Consulting Engr. & Secy., Federated Laboratories, New York, N. Y. | G. M. Maier<br>F. B. Howell | W. R. Zuhlke<br>C. H. Flink |

# Candidates Elected

In past issues of the Journal of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Membership Committee and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. II, Sec. VIII, of the By-Laws, the following list of candidates elected:

## MEMBERS

CORLETT, LAWRENCE DONALD, Smith, Hinchman & Grylls, Detroit, Mich.
CUNDALL, LINCOLN ATWOOD, Estimator & Asst. to Pres., L. A. Harding Constr. Corp., Buffalo, N. Y.
FALTENBACHER, HARRY JOHN, Plbg. & Htg. Contractor, 235 E. Wister St., Philadelphia, Pa.
HARNEY, FRANCIS W., Dir. of Engrg. Research, Upson Co., Lockport, N. Y.
HOYT, LEROY W., Genl. Supt., Richards & Jessup, Inc., Stamford, Conn.
JUNG, JOHN S., Htg. & Vtg. Contractor, 554 Layton Bldg., Milwaukee, Wis. (*Advancement.*)
KNAB, EDWARD A., Pres., Edward A. Knab, Heating Contrs., Milwaukee, Wis. (*Advancement.*)
MORRILL, FRANK BAXTER, Engr., Buck Dryer Corp., New York, N. Y.
OLSEN, GUSTAV E., Mgr. of Sales, Fitzgibbons Boiler Co., Inc., New York, N. Y.
ROLLINS, LEONARD EUGENE, Designer, Smith, Hinchman & Grylls, Detroit, Mich.
TRULSON, ARTHUR F., Smith, Hinchman & Grylls, Detroit, Mich.
TURNER, JOHN, Sales Engr., Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
WELDY, LLOYD O., Powers Regulator Co., Chicago, Ill.
YEOMANS, PAUL H., Armstrong Cork Co., Lancaster, Pa.

## ASSOCIATES

ARNOLDY, WILLIAM FRANK, N. E. Branch Mgr., Minneapolis-Honeywell Regulator Co. of Minneapolis, Boston, Mass.
BUCKLEY, JOSEPH L., Carrier Engrg. Corp., Philadelphia, Pa.
COX, HARRISON F., 243 Carroll St., Paterson, N. J.
GROOM, HAROLD L., Ch. Engr., Erection & Service Depts., Carrier Engrg. Corp., London, England.
HARE, W. ALMON, Manager, Stoker Div., Whitehead & Kales Co., River Rouge, Mich.
STEWART, DUNCAN J., Experimental Engr., Barber-Colman Co., Rockford, Ill.

## JUNIORS

ANDERSON, SAMUEL WILSON, JR., Carrier Engrg. Corp., Newark, N. J.
BEITZELL, ALBERT ERNEST, Carrier Engrg. Corp., Newark, N. J.
BURKE, JAMES, Carrier Engrg. Corp., Newark, N. J.
CASPERD, HENRY W. H., Carrier Engrg. Corp., Newark, N. J.
CRAWFORD, JOHN HUMPHREY, JR., Carrier Engrg. Corp., Newark, N. J.
EDMONDS, ALBERT SIDNEY, JR., Carrier Engrg. Corp., Newark, N. J.
FAUST, FRANK H., General Electric Co., Fort Wayne, Ind.
FENN, CHARLES VAN ORDEN, Carrier Engrg. Corp., Newark, N. J.
GAMMILL, OSCAR ELBRIDGE, JR., Carrier Engrg. Corp., Newark, N. J.
HEARD, JOHN ARTHUR EDWARD, Carrier Engrg. Corp., Newark, N. J.
MARSH, ARTHUR BLISS, Carrier Engrg. Corp., Newark, N. J.
MITCHELL, ANDREW JACKSON, Carrier Engrg. Corp., Newark, N. J.
MOLINET, IGNACIO S., Carrier Engrg. Corp., Newark, N. J.
RACHAL, JOHN MEREDITH, Carrier Engrg. Corp., Newark, N. J.
RAISLER, ROBERT K., Raisler Htg. Co., 129 Amsterdam Ave., New York, N. Y.
REX, HARLAND E., Carrier Engrg. Corp., Newark, N. J.
RISER, SPENCER P., Carrier Engrg. Corp., Newark, N. J.
SCOTT, LESLIE O., Carrier Engrg. Corp., Newark, N. J.
SHARPE, NORMAN, Carrier Engrg. Corp., Newark, N. J.
SHIELDS, MORTON KINGMAN, Carrier Engrg. Corp., Newark, N. J.
WILLETT, WILLIAM MCN., York Htg. & Vtg. Corp., Philadelphia, Pa.
ZELLWAGER, LOUIS S., Carrier Engrg. Corp., Newark, N. J.
WILLIAMS, LEO ERNEST, Carrier Engrg. Corp., Newark, N. J.

## STUDENTS

ADAMS, WILLIAM HERBERT, South Main St., Colchester, Conn.
BABBITT, WILLIAM D., Carnegie Inst. Tech., Pittsburgh, Pa.
BEATY, GUY MEBANE, JR., Carnegie Inst. Tech., Pittsburgh, Pa.
BROWN, WILLIAM MURRAY, Carnegie Inst. Tech., Pittsburgh, Pa.
GILMORE, LOUIS ARTHUR, Carnegie Inst. Tech., Pittsburgh, Pa.
GRANSTON, RAY OLIVER, Carnegie Inst. Tech., Pittsburgh, Pa.
JALONACK, IRWIN GEORGE, Carnegie Inst. Tech., Pittsburgh, Pa.
JOHNSON, KENNETH E., Carnegie Inst. Tech., Pittsburgh, Pa.
KLEINE, ROBERT E., Carnegie Inst. Tech., Pittsburgh, Pa.
LABOV, MILTON, Carnegie Inst. Tech., Pittsburgh, Pa.
NEFF, CHARLES JOHN, Carnegie Inst. Tech., Pittsburgh, Pa.
PETERSON, CLARENCE OSCAR, Carnegie Inst. Tech., Pittsburgh, Pa.
PETTIT, ERNEST N., JR., Carnegie Inst. Tech., Pittsburgh, Pa.

Heating · Piping
and Air Conditioning

# EDITORIALS

## The Replacement Engineer

Practically ten years have passed since the panic of 1920—ten years full of economic experiences such as have never been known in this country before. To those who are able to read the directional signs there is profit. To others who refuse to see the warning signals, losses, and even disaster, are likely to come.

Formerly the heating, piping and air conditioning manufacturers and contractors gave their entire attention to new work. No one would look at a job which involved only small replacements. Many installations which were inefficient were completely torn out and replaced by more modern equipment even though some small changes would perhaps have brought the old plant to equivalent efficiency.

It is high time that we see the engineering possibilities in remodeling and rejuvenating the old plant. A new type of engineer must be developed—an engineer who knows from personal experience how to investigate inefficient equipment, how to correct the manifold troubles which are inherent in old installations and what should be done to bring such plants back to a further useful life.

This type of business will not hurt the sale of new installations, but it will bring to life frozen business and markedly increase the demand for replacements. Today the few engineers who are in this field have little or no competition, and they keep their manufacturing plants busy even when business as a whole slumps off.

## A Natural Relationship

There are two fundamental reasons why heating, piping and air conditioning should be grouped together —first, because they are related mechanical services and, second, because they are the work of the one engineer or contractor.

Heat or heated treated products must be distributed or conveyed, and it is a natural relationship, therefore, for heating and piping to be of the same family. Of course, there are liquids, gases and solids that are piped without the direct application of heat. Similarly, a piping system is not the medium for distributing all kinds of heat. But these two exceptions do not alter the natural relationship of heating and piping.

Air conditioning makes use of both heating and piping and contributes its own refinements in its application to the manufacturing processes or to human comfort and health. In its dependence upon the first two lies obvious reason for grouping the three as a field or profession of their own.

This relationship of services is paralleled by the relationship of interests of those engineers and contractors who design, install and operate heating, piping and air conditioning systems and equipment. Those whose work or interest is in any of the three are, as a rule, working or interested in all of the three.

Thus, heating, piping and air conditioning go together to constitute an industry, a profession, a field that is one of the most important in engineering, from the viewpoint of service and from the viewpoint of capital invested.

## The Census

Manufacturers of heating, piping and air conditioning equipment and specialties owe it to themselves and to the industry to co-operate fully with the Bureau of the Census in filling out the forms for the 1929 Census of Manufacturers. Manufacturers are urged by the Bureau to fill out and return the forms within fifteen days of receipt of the blanks.

An important characteristic of statistics such as those that will be contained in the Bureau of Census report on manufactures is their timeliness. According to a letter from the Bureau, it is able to get out the preliminary survey on a given industry within three weeks from the time that the information from all the manufacturers has been received. As all of the forms have now been received by the manufacturers (or will be within a few days), it is up to the industry to see to the value of its survey, as far as timeliness is concerned.

The benefit of this census comes chiefly to the manufacturers themselves. While the information requested on the questionnaires is rather detailed, it is all designed to answer questions which have been requested by the industries, and to supply information and indications which will be of great value to them. While the law requires that the census questionnaires be filled out, it is the policy of the Bureau to encourage voluntary co-operation rather than to enforce penalties.

A national census of distribution is being taken for the first time this year also. It is designed to give a definite, statistical picture of the movement of goods from the producer to the consumer. It is expected that the first preliminary reports will be available during the latter part of this year.

Co-operation with the government in taking stock of industry should be an important and recognized duty of every member of this industry.

# INTERVIEWS OF INTEREST

## School Room Ventilation

A. C. Willard, professor of heating and ventilating, and head of the department of mechanical engineering, University of Illinois, discussed with us tentative reports issued in September on the final studies of the *New York Commission on Ventilation.* Notwithstanding these successive reports on school room ventilation and their reiterated statements with respect to child health and the atmospheric environment of the school room, it is Professor Willard's opinion that we must regard acute respiratory disease incidence entirely inconclusive as a measure of ventilation efficiencies.

"It is important to give consideration to these studies," he said. "It is always imperative to incorporate proved factors of air hygiene in apparatus design and in management routines. But on the basis of the New York reports evidence is inconclusive with respect to the incidence of acute respiratory disease.

"The earliest reports declared that excess heat was the basic fault of incriminated ventilating systems. Perhaps the most surprising thing in the recent reports is that the high temperatures recorded in some of the favorable rooms are held to be of little moment. Some of the so-called open window rooms had consistently high temperatures, and statistical evidence revealed relatively slight incidence of 'colds.' Mr. Thomas J. Duffield thinks the temperature factor not vital. Mr. Duffield should define 'high temperature.' His evidence is not conclusive enough.

"The sad thing is that no one is agreed upon any criterion of air hygiene. Dr. F. E. Harrington, health commissioner of Minneapolis and health director in the public schools, declares that the statistical percentage variations recorded throughout the course of these studies have been too small to be significant.

"How about the eighteen hours a day not spent in school? No one can separate out the causes that underly the sudden fluctuations in the incidence of acute respiratory disease. Unusually extensive measures are undertaken to promote child health in Minneapolis, but the emphasis there is placed upon pre-tuberculous conditions and chronic chest involvement.

"Pittsburgh supports child health clinics on an unusually extensive scale in the schools under the able direction of Dr. H. B. Burns. Here, too, prevention is directed against chronic states of health which predispose to tuberculosis."

Professor Willard went on to state that it would be a great advantage if one could show positively and dramatically that any one air environment is best for health. It has not been done.

Professor Willard holds that in a densely occupied room (school), controlled ventilation of some kind is necessary. "One can ventilate some rooms by means of open windows," he said. "To ventilate the entire school building by this means is to ignore the air effluvia that flows across the building from the windward side. Heat and air drifts are the bane of ventilating engineers. They can never be ignored.

"Many of the newer buildings going up at the present moment are turning to zone control. One closes now the source of heat on south and east when winds are north and west. It is useless to discuss open windows as a solution of these ventilation difficulties, for only the floors on the lowest levels of tall buildings, where a chimney effect pulls in the air, can be so ventilated.

"The mild climates of our southern states, and southern California are the only suitable situations we have for open window ventilation methods in schools."

Comments by other authorities in the heating and ventilating field on this subject will be considered by this publication.

## Heating Research

A. P. Kratz, research professor, department of mechanical engineering, University of Illinois, in investigative work under the direction of Professor A. C. Willard, and assisted by M. K. Fahnestock and M. S. Konzo, special research assistants, has been occupied of late with radiator problems and with other research effort undertaken to discover criteria of air motion and heat distribution that will determine the effectiveness of a given heat unit, and whether it is satisfactory.

"Some conditions relate to the comfort of the occupant of a room without representing actual heat losses that are reflected in the efficiency of the unit," states Professor Kratz. "Our work is not so much concerned with the room as a calorimeter as it is with the actual heat distribution within the room.

"There is a popular misconception of what is meant by the 'comfort zone.' Engineers are not claiming the comfort chart as an index of health. There may be no correlation between comfort and health. The engineers' use of the comfort chart is not applicable to each and every individual. It is an average index of proper air conditions. It can only represent the average.

"What our research laboratories have been trying to do is to chart the actual heating effects of common heating units, as radiators, enclosure, etc.

"Theoretically, the ideal way to heat a room would be to have a warm baseboard all round the room; but this cannot be set forth as a general principle until an experimental room has been set up and actual heating effects are studied. Heat losses need to be measured, and charts made of the air currents and other factors of importance within the room.

"This would relate strictly to conditions within the room itself that affect heat losses. Insulation of given surface has one effect. Other combinations require to be studied, and other types of enclosure. Our present study of insulation effects upon inside currents presents many possibilities of controlling air currents within the room and promises interesting results."—*S. P. M.*

**PRACTICAL PIPING PROBLEMS**

# *A Strainer Assembly*
# *Drip on Boiler Feed Line Is Useful*

*by* **W. H. WILSON**

## Strainers for Pipe Lines

The sketch, Fig. 1, shows a strainer made from standard pipe and fittings, excepting the basket. A strainer of this type would be suitable for use on water supplies for furnace cooling water, fixtures not requiring city water, and service water for similar purposes.

The size and length of the basket, together with the size of the perforations or mesh, will be governed by the amount of water needed and the condition of the water. The size of the pipe and fittings will be governed by the dimensions of the basket.

The dimension *B*, outside diameter of the basket flange, is the same as the outside diameter of a ring gasket that will fit inside of the bolts of the flanged fitting used. The inside diameter of the tee (size of tee) should be larger than dimension *A*, so as to provide a reasonable clearance between the outside of the basket and the inside wall of the pipe and fitting, to provide space for the water flow. Ordinarily, for a 2-in. water line, a 4-in. flanged tee and a section of 4-in. pipe will be satisfactory.

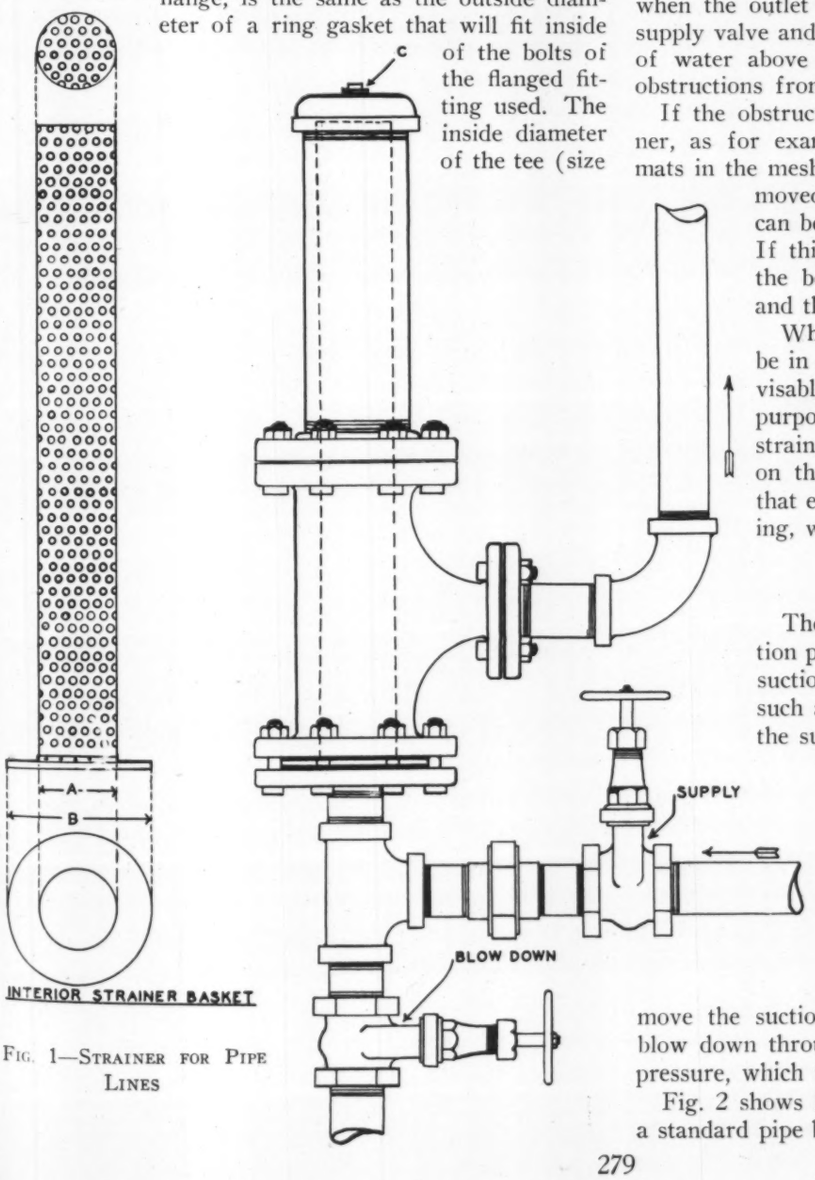



FIG. 1—STRAINER FOR PIPE LINES

The sketch shows the general arrangement, which may be varied to suit material that may be on hand. A tee with a screwed outlet could be used or a piece of pipe with a branch connection welded on the side can be used instead of the tee.

The strainer should be installed, if possible, in a vertical position, as this will assist in cleaning, especially when the outlet pipe extends upward. By closing the supply valve and opening the blow-down valve, the head of water above the strainer will help to remove the obstructions from the strainer basket.

If the obstructions can not be removed in this manner, as for example, in case grass or fine vegetation mats in the mesh of the strainer, the plug *C* can be removed and water or compressed air pressure can be used for blowing through the strainer. If this does not produce the desired results, the bolts can be removed from the flanges and the basket taken out for cleaning.

When the water supply line is required to be in continuous use, and it would not be advisable to shut off the water supply for the purpose of cleaning the strainer, two of these strainers can be installed, with shut off valves on the inlet and outlet of each strainer, so that either strainer may be shut off for cleaning, while the other one is in use.

### Suction Strainer

The suction strainer will protect the suction pipe from becoming obstructed, when the suction is used in water containing impurities, such as large particles of mill waste. When the suction pipe is used with a small strainer on the bottom of the pipe, it is a simple matter for a piece of paper or similar material to be drawn to the outside of the strainer, obstructing the intake of the water.

### Cleaning

In case the strainer becomes obstructed and it is not convenient to remove the suction pipe, arrangements can be made to blow down through the suction pipe with water or air pressure, which will help to clean the strainer.

Fig. 2 shows how the strainer is assembled by using a standard pipe bushing and running a pipe tap through